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ADVENTURES
IN THE AIR

ADVENTURES IN THE AIR.

Frontispiece.

NIGHT SCENE FROM THE "NASSAU" BALLOON.

ADVENTURES IN THE AIR.

BEING

MEMORABLE EXPERIENCES OF GREAT AERONAUTS.

FROM THE FRENCH

OF

WILFRID DE FONVIELLE.

TRANSLATED AND EDITED BY

JOHN S. KELTIE.

With Numerous Illustrations.

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PREFACE.

M. DE FONVIELLE'S 'Aventures Aériennes,' of which the present work is mainly a translation, does not pretend to be a complete history of ballooning, but simply a collection of some of the more notable incidents that have marked the progress of the science and practice of aeronautics.

The Translator thinks it due to the Author to state, that in this English edition several passages likely to interest only French readers have been omitted, and several additions made bearing mainly on the history of ballooning in England. The whole has, moreover, been carefully revised by both Author and Translator, the former having added some further details, bringing the work down to the present date. A few new illustrations have also been added, and in its present form it is hoped that the work will afford pleasure to both young and old, and lead the former especially to take an interest in those sciences on which aeronautics is based.

The Translator acknowledges the kindness of James Glaisher, F.R.S., in revising the proofs, and of Mr. Coxwell, in making some important corrections on that part of the work in which he is referred to. Thanks are also due to Messrs. Bentley, the proprietors of 'Temple Bar' magazine, for permission to make use of M. de Fonvielle's article, "How I came out of Paris in a Balloon."

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ADVENTURES IN THE AIR.

CHAPTER I.

SOAP BUBBLES.

THE conquest of the air probably commenced like that of the water: the first navigators were not the inventors of submarine vessels, imitating more or less awkwardly the organisation of the fishes. They were probably plucky savages who, clinging to a stray tree-trunk, shot fearlessly into the current of a river or on to the crest of the ocean wave. It did not certainly require long years of research and experiment to learn how to utilise a tree already hollowed out by nature, nor even to excavate the first canoe from a trunk which chance had left entire. By moving the branch of a tree through the water, the oar would ere long be suggested. The sail and the rudder would by-and-by follow; for one step in advance leads to another, the first alone being trembling and uncertain.

How slow, on the other hand, has been the progress in aerial navigation. The resistance of the air is not patent like that of water, for the particles of air divide with a most uncomfortable rapidity when one happens to fall even a few feet. How many clever enough men have walked this earth without even realising the fact that they lived and moved in the midst of a material medium. Yea, even at the present day, there are many intelligent and educated men, even men of science, who do not know that there is really no dynamical difference between air and water if we strike the former with a rapidity surpassing that of oars in proportion to the different densities of the two mediums. The dreamers who have tried to rise from earth by devising for themselves artificial wings have done no more for the navigation of the air than the witches of the story who rose through the air on a broomstick.

The conquest of the air really dates from the memorable day when Galileo told the pump-makers of Florence that nature only abhors a vacuum to the height of thirty-two feet. For the great martyr to science, having exactly ascertained the weight of air, had only to find a lighter body; and if, besides, some means could be devised of holding it fast, mortals might be able to traverse the pathway of the clouds. At one time indeed it might have been thought that the means of mounting aloft had at last been found, when the Burgomaster of Magdeburg, Otto Guericke, discovered the air-pump, by which a hollow sphere may be deprived of all the air it contains. But when he considered the lightness of the mass of air enclosed in his copper globe, and the thickness which must be given to the metal composing the hemispheres to prevent them from being crushed, he must have been devoid of sense to have retained any such illusions. Only fools could imagine, as did the Jesuit Lana, that it would ever be possible to devise any really practicable means of locomotion from an apparatus of a weight so comparatively prodigious. But the discovery of gases, or, as they were called at first, airs, was not long in suggesting to scientific men the invention of balloons. Twenty years before balloons were invented, the scientific principles of aerial navigation were accurately ascertained and published.

In 1766 Cavendish discovered what was then known as "inflammable air," but which we now call hydrogen gas, by the action of sulphuric acid upon metals. He had even learned how to collect it by means of a bladder of gold-beater's skin, as will be seen by a figure which accompanies his Memoir in the "Philosophical Transactions."

Thus the substance which fills balloons and the material of which they are made, had been found out. By a little reflection and investigation it was shown that man had no need of the chimerical wings of Dædalus, since he held in his hands a ship which would enable him to float beyond the clouds. The poets represented the queen of love in a chariot drawn by doves. This graceful myth might well be taken to represent aerial navigation by means of balloons; but instead of putting bit and bridle upon birds, it is the impalpable spirit, air itself, which is made to draw us along when we have learned how to imprison it. Weight overcomes weight; a moving force, sufficiently powerful, applied with intelligence, may strive successfully with that powerful but variable and capricious force, which we call the wind.

A prominent name in connection with the early history of ballooning is that of Joseph Black, the eminent professor of chemistry at Edinburgh University towards the end of last century. Black, though of Scotch parentage, was born at Bourdeaux in France in 1728; he died in 1799. In the course of his professorial lectures about 1766, Black suggested the idea of raising any weight whatever by attaching it to a large sphere filled with inflammable air, *i.e.* hydrogen gas, and allowing it to fly off. As Cavendish had determined the specific weight of hydrogen, it was now known that it was as one-thirteenth of the weight of common air. Black went so far as to request Dr. Munro, the professor of anatomy, to give him some thin animal membrane with which to try the experiment, but for some reason or other it seems never to have been made, although it is on record that Black did actually fill a bag with hydrogen that rapidly rose to the ceiling of the room.

Black's idea was not lost sight of; an accomplished natural philosopher, or physicist, to use the more modern term, who cultivated science in the leisure left him after business, some years later shewed that the thing could be done. This was Tiberius Cavallo, an Italian gentleman settled in London as a merchant. Cavallo, having examined the strong paper used for drawing, thought it would be sufficient to hold the light gas. Indeed he failed to perceive, even by means of a magnifying glass, any pores through which fluid, however subtle, could escape. This substance seemed to him to possess a uniformity of texture and an impermeability which did not belong even to gold-beater's skin. He carefully manufactured some bags into which he put his gas, but through which, alas, his gas escaped. If it had occurred to Cavallo to saturate his bags with oil he would have succeeded admirably. The ingenious Cavallo was not, however, discouraged, but turned his efforts in another direction; he bethought him of collecting his gas in soapy water, such as children are in the habit of using for blowing soap-bubbles. This time the experiment was a complete success; the bubbles which enclosed a portion of the hydrogen gas took flight and rapidly disappeared. This was in 1782.

Thus then the balloon may be said to have been invented. It was necessary, however, to find a solid envelope which would enable it to be utilised, and above all to make it of a size that would remove it from the category of toys. This Cavallo did not attempt. He contented himself with shewing to his colleagues of the Royal Society his beautiful experiment. They all congratulated him on the discovery of a fact so curious, requested him to repeat the experiment at one of the public meetings of the Society, and describe it in their "Transactions." Thus, in England at any rate, the question of aerial navigation did not in the meantime advance beyond soap-bubbles.

But the celebrated Priestley, one of England's greatest scientific worthies and most prolific writers, did not omit to mention so curious a discovery. He described it in terms of high praise in his "Experiments and Observations of the Different Kinds of Airs," which, containing his own discoveries, produced considerable sensation, and was immediately translated into French. Priestley may thus be considered as the link of connection between Cavallo and Montgolfier, a memorable name in the history of ballooning.

CHAPTER II.

MONTGOLFIER'S FIRST ATTEMPTS.

We have no intention to write a work of profound research, and therefore shall not step aside to examine into the truth of the statement that a certain Don Guzman had made an ascent, either at Lisbon or in Brazil, long before the time with which we are now occupied, especially as these attempts, of which we have only the most meagre account, altogether insufficient to judge of their reality, were stifled by ignorance and superstition. Here, however, it may interest the reader to mention a very curious circumstance recently brought to light. Upwards of three years ago there was published in the "Bulletin International" of the Paris observatory a letter from M. Charrel of Marseilles. In this it is pointed out that in the literary history of the city of Lyons, published by Father Colonna (1830, vol. i. p. 112), it is stated that in the reign of Louis le Débonnaire, the Archbishop of Lyons learned that some aerial navigators had fallen with their boat on the banks of the Saone, and were about to be put to death as sorcerers. The prelate ordered them to be brought into his presence, and after having heard them caused them to be discharged. The Memoir of the Archbishop bears such a character of authenticity as makes one hesitate to doubt the fact. If true, it would of course follow that already in the ninth century aerial navigation was known; how it was accomplished the Memoir does not give any indication. At all events ballooning was practically an original invention of the time with which we are at present dealing, though we cannot accord unreservedly all the right of the invention to Montgolfier. In fact, even if we put entirely out of count events in the least problematical, we cannnot admit a learned man to be ignorant of the publications of a neighbouring country, more especially when these have been translated into his native language.

Nearly all French authors have deemed it merely an act of patriotism to invent a multitude of legends for the purpose of explaining, more or less poetically, the manner in which Montgolfier conceived the first idea of his globe of heated air. But we only detract from the glory of inventors by throwing a veil over their errors or by concealing the sources from which their genius was fed. There are chroniclers who tell us that Montgolfier was struck by observing the manner in which clouds swim through the air, which seems to have difficulty in supporting them. He is said to have fancied that these mountains which float over our heads are hollow like immense vessels filled with light gas. Others state that the young paper-maker of Annonay (for such was his calling), being on one occasion in an inn at Avignon, saw a chemise fly off, which had been placed on a chair before the fire for the purpose of airing it. He conceived on the spot, it is said, the idea of heating air and enclosing it in a paper-box. We willingly leave it to others to choose between two contradictory stories, both equally improbable. We prefer to believe that the young man was sufficiently up in matters of science and fond enough of novelties to have read the translation of Priestley's work, which was doubtless on sale in the bookshops of the neighbouring town of Montpellier. Montgolfier may probably enough have had this work in his hands, and his merit is none the less in our eyes, for it was the laudable ambition of aiding France in the great war of American independence that animated his young mind.

While Montgolfier was staying at Avignon, in 1782, the fortress of Gibraltar was holding out bravely and defiantly against the combined forces of France and Spain. In vain had vessels with iron rods been constructed to resist the shock of the cannon balls; driven by necessity the British found the means of defying their then terrible enemies by means of fire-ships, red-hot balls, stinking missiles and other deadly ingenuities. The success of the war, for which Montgolfier, like all liberal Frenchmen, longed, seemed likely to be compromised by a check as bloody as it was unexpected. "I possess a superhuman means of introducing our soldiers into this impregnable fortress," cried Montgolfier in a moment of enthusiasm. "They may enter through the air; the gas produced by the combustion of a little straw or a few rags should not pass, like the subtle inflammable air, through the pores of a paper bag. By making the bag large enough, it will be possible to introduce into Gibraltar an entire army, which, borne by the wind, will enter right above the heads of the English."

JOSEPH MONTGOLFIER.

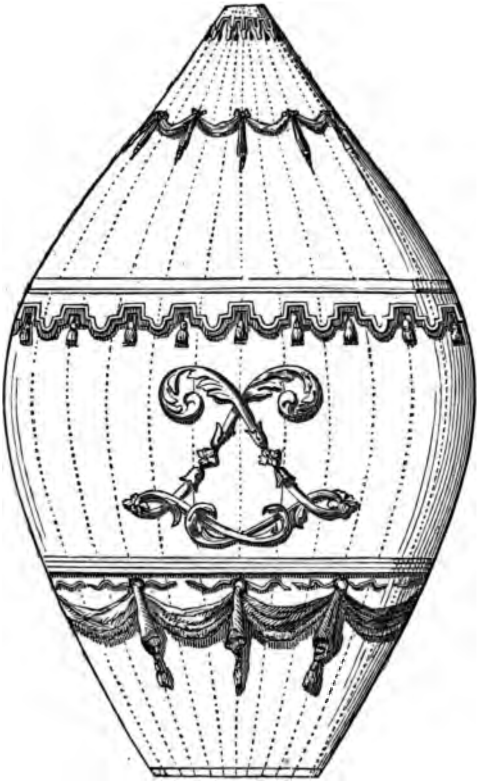
Forthwith Montgolfier put his brilliant and simple idea to the test of experiment, and had the gratification of seeing a bag ascend from the floor. This was in November 1782.

With soap-bubbles, then, and a paper-box began the conquest of the air.

To show a few of the results of the fruitful researches which these two discoveries originated is our sole object in the present work. We shall ignore as far as possible the dreamers, charlatans and quacks who have taken almost exclusive possession of the navigation of the air, and who would render it ridiculous if the chimeras of men were able to detract from the value of what is really simple and great.

Joseph Montgolfier returned to Annonay, where was the paper-mill of his father, who was still alive. Here he took his brother Stephen, to whom he was greatly attached, into his confidence, and made him the associate of his schemes and labours. Montgolfier obtained what he called his gas from a mixture of straw and chopped wool to which he had set fire, and which of course when attached underneath the opening of the balloon would have the effect of rarifying the air therein and therefore lightening it. It was an economical process, and no time was wasted in expanding the balloon.

From the first the Montgolfiers used dimensions which the celebrated Magdeburg spheres never possessed. The first machine which they sent up in the open air had a capacity of 650 cubic feet. It may be said that the first really important attempt surpassed the hopes of the inventors, for the balloon escaped from their hands, like a fiery steed that had escaped from the stable. It came down on the neighbouring hill after having risen to a height estimated at 900 feet. This far exceeded the height reached by the most brilliant rockets used in fireworks displays.



OLD MONTGOLFIER WITHOUT THE CAR.

Having succeeded in this first experiment, the inventor ventured to inflate a much larger machine, one not less than 35 feet in diameter, certainly a great advance on the soap-bubbles of Cavallo. It could raise 450 pounds weight, or nearly 900, including its own weight. This great attempt, which took place on the 3rd April, 1783, was frustrated by the wind; but on the 25th, the experiment was renewed under more favourable atmospheric conditions, and with complete success. The balloon rose and remained suspended in mid air for ten minutes, coming to earth at a distance of 200 feet from the place at which it was let go.

Even at the time when the public press was in its infancy in France, so wonderful an experiment could not long remain unnoticed. The Montgolfiers proposed to M. d'Ormesson, Intendant of the Vivarais to repeat it in presence of the States-General of the province, about to assemble. The first great public exhibition took place on June 5, 1783. The machine—a linen globe 105 feet in circumference and with a capacity of 23,000 cubic feet—filled with the smoke produced by burning a few handfuls of moist straw, rose quietly and almost majestically to a height of 6000 feet, returning to earth when the gas was dissipated.

CHAPTER III.

THE FIRST LOST BALLOON.

MONTGOLFIER'S invention immediately became the great event of the day. The Academy of Sciences, which had been officially informed of the occurrence, decided that the incredible experiment of Annonay should be repeated under the eyes of His Majesty the unfortunate Louis XVI. But Mr. "The General Public," that anonymous majesty whose reign was just beginning in France, was much better served than the head of the House of Bourbon.

There was then in Paris a public professor of physics, celebrated for the success with which he performed the most difficult experiments, for the completeness and perfection of his instruments, and for his brilliancy as a lecturer. M. Charles could not wait patiently for the spectacle which the Academy was preparing for the courtiers. He determined to be beforehand with them and be the first to give the Parisians a new treat.

The so-called gas of Montgolfier was heavy; its weight was three-fourths of that of the air, while that of inflammable air (hydrogen) was thirteen times lighter. The difficulty of preparing the latter was mere child's play to Charles, who made use of it daily. The problem of collecting it into an impervious envelope was also solved, for caoutchouc had been discovered, and Charles knew how to prepare a thin sheet.

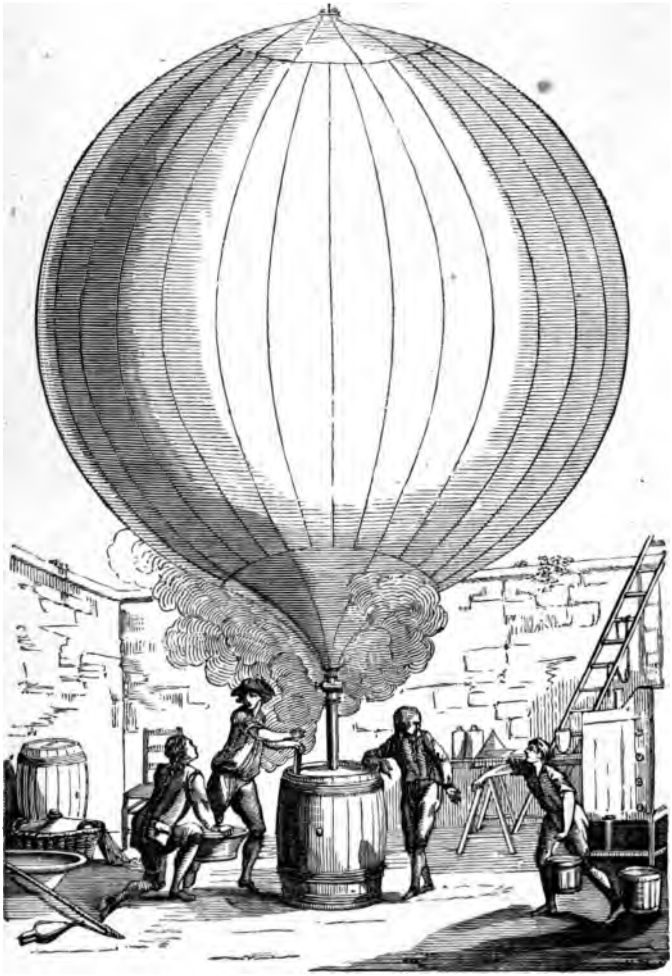
The only want now was money, to accomplish Charles's scheme, but his friend Faujas de Saint-Fond would find that. This Faujas was one of those restless individuals who are frequently met with in the history of ballooning. He was then *préparateur* of the cabinet of the King; he had been, it would appear, a fellow-worker with the celebrated Buffon for a short time; he had visited all parts of Europe for the purpose of making geological observations; he was well off, and found himself in the world with nothing particular to do. One of his friends was just then landlord of the *Caveau* Café, a place much frequented by the littérateurs of Paris. Here then was opened a subscription, the condition of which was that each subscriber of a crown would have the right of entry to the enclosure from which the ascent was to be made, and could bring two friends. The true balloon, that of M. Charles, cost the State nothing; an example which the organisers of aerial experiments ought not so frequently to forget.

When the Montgolfiers arrived at their hotel in Paris, they were already too late to gather the first fruits of the discovery which formed part of their baggage. Charles's balloon was sewn together and varnished, and there was nothing more to do but to inflate it with a better gas than theirs. The poor Montgolfiers had lost both the King and the

Academy; their very machine had been taken out of their hands, as it were. Paris, during the time they had taken to reach it, had reinvented balloons.

Charles manufactured his bag in accordance with geometrical principles. He gave it a spherical form, the most solid and perfect of all for the purpose; with the least weight, it gives the greatest capacity. This balloon was 30 feet in diameter, and weighed only 25 lbs. instead of 400 lbs., as did Montgolfier's machine. In this weight was included a very dangerous appendage, but which was thought indispensable—a pipe with a tap placed at the lower part. Charles was very proud of the tap, and had great confidence in its effect, for the balloon of the Montgolfiers had a hole in the same place, by which, as they neglected to close it, all their gas escaped. But with this tap of M. Charles, there was no reason whatever why the balloon should fall; it could only lose its power, little by little, on the 71
principle of endosmose, or interchange of gases. The Count Vergennes, French Minister of Foreign Affairs, notified diplomatically all the European governments of the construction of a wonderful machine which would land one day or other upon their territories. They were requested to notify the Court of France of the fall, in order that the Academy might be informed of the fact. It is even said that, under a flag of truce, a messenger was sent to the King of England, with whom France was then at war, in order that the Court of St. James might not be ignorant of the momentous event.

History has preserved a record of all the accidents



INFLATION OF THE FIRST AIR-BALLOON.

Page 17.

which the operators successively experienced. There had been constructed with great care, for the preparation of the hydrogen, a sort of large chest of drawers. Each drawer was of lead, and in communication with a tube attached to the balloon. This was very good, but the loss of hydrogen was so great that for an experiment of such prime importance, it was found necessary to make use of a common cask with two holes pierced in its upper end; one of these communicated with the balloon and by the other was introduced the iron filings and the sulphuric acid from which Charles manufactured his hydrogen. Soon it was seen that the action of the acid produced an inconvenient heat, which might mar the inflation or injure the balloon. The remedy was rude but efficacious; the cask was kept saturated with water. It was then thought advisable to free the gas from the mixture of acid it would take along with it, and this was done by making it pass through water on its way to the balloon.

But, worst mishap of all, they left for the night, forgetting to shut the famous tap referred to already, and next day on returning, they found the gas they had prepared with so much care greatly spoiled. The atmospheric air had entered in such quantity, although the mouth of the balloon was underneath, that Charles and his assistants were obliged to empty it and commence the inflation afresh.

It had at first been intended to launch the balloon from the place where it was inflated, in the neighbourhood of the Place des Victoires and the *Caveau Café*, but the number of those desirous of witnessing the strange sight was so great that they were obliged to carry it to the Champ de Mars. But before setting out they could not resist the temptation of trying its strength. Charles proved that it possessed an ascending force of 21 lbs., and that it could rise dragging a rope 100 feet long. As soon as the balloon was seen in the air, the crowd doubled. It was impossible to take the balloon through Paris during daylight, and it was therefore necessary to do so at night, by torchlight, accompanied by a detachment of soldiers, at the risk of setting the balloon on fire; but this was a less serious danger than the risk of having it torn to pieces by the inquisitive crowd.

It was on August 27th, 1783, that the great experiment or rather fête took place, and the minutest details of the event have been preserved. The Champ de Mars was surrounded by a guard of soldiers to prevent those who had not tickets from entering the reserved space. But the avenues, streets, roofs, quays were crowded with spectators waiting impatiently until the *Globe*—the name which had been conferred upon the balloon—should ascend. At last, about five o'clock in the afternoon, a cannon was fired as a signal, and the *Globe* rose majestically from the earth. A shower of rain fell immediately after, but this did not in any way impede the ascent, and was apparently unheeded by the thousands of well-dressed spectators, including many fashionable ladies, who intently watched the wonderful spectacle. All eyes were riveted on that light sphere, which now disappeared in the vapour of a cloud, but soon again came into sight, its reappearance being greeted by a second salvo from the cannon. It was soon, however, lost sight of again. Several well-known astronomers had posted themselves upon the public buildings to take measurements, as if they wanted to determine the orbit of a planet or the path of a meteor. Yet not one of these notable savants could give the least news of the balloon. It was only next morning that it became known that it fell about an hour after its ascent, in a field at Gonesse, about 15 miles off. It had been torn to pieces by the superstitious and terrified peasants.

The success of this experiment put the imagination of inventors quite into a fever. M. Deschamps, an artist, proposed to the Baron Beaumanoir to place aeronautical experiments upon all the stock-exchanges. He attempted to construct balloons of gold-beater's skin, a substance which unites by mere juxtaposition when it is fresh, and which, moreover, is very easy to varnish. The first balloon of this kind was ready to be sent up on September 11, 1783; it disappeared in the clouds and was no more heard of. Its diameter was only 15 inches, but even this was found to be too large. Multitudes repeated the experiment of the Baron de Beaumanoir with little balloons of 6 inches. Immediately these pretty playthings became quite the rage in Paris; they were made in the most grotesque forms.

During the inflation of Charles's balloon there occurred a little scene to which we must refer as being characteristic, and because it has been reproduced in a thousand different forms in the history of ballooning. Charles had discovered that it would be necessary to give his *Globe* a supplementary supply of gas just before launching it into the air. For this purpose he had conveyed to the Champ de Mars a cask to complete the inflation, which was placed in a special enclosure, surrounded by canvas, admission to which was strictly forbidden to any one not immediately engaged in the experiment. Montgolfier, it is said, presented himself at the entrance to this sanctuary, but was refused admittance, Charles himself guarding the door. This manner of treating the modern inventor of aerial navigation was not relished. The public at first showed so much disapprobation that it was thought necessary to send for a squadron of soldiers. But the departure of the *Globe*, which was not delayed, made the fickle public forget its discontent and even poor Montgolfier. It is stated that Charles yielded to the advice of Faujas, who had as much to do with aerial navigation as the fly with the movement of the coach-wheel, but who could only profit by the estrangement of the inventors, and went about telling everybody that he had an important share in these innovations.

CHAPTER IV.

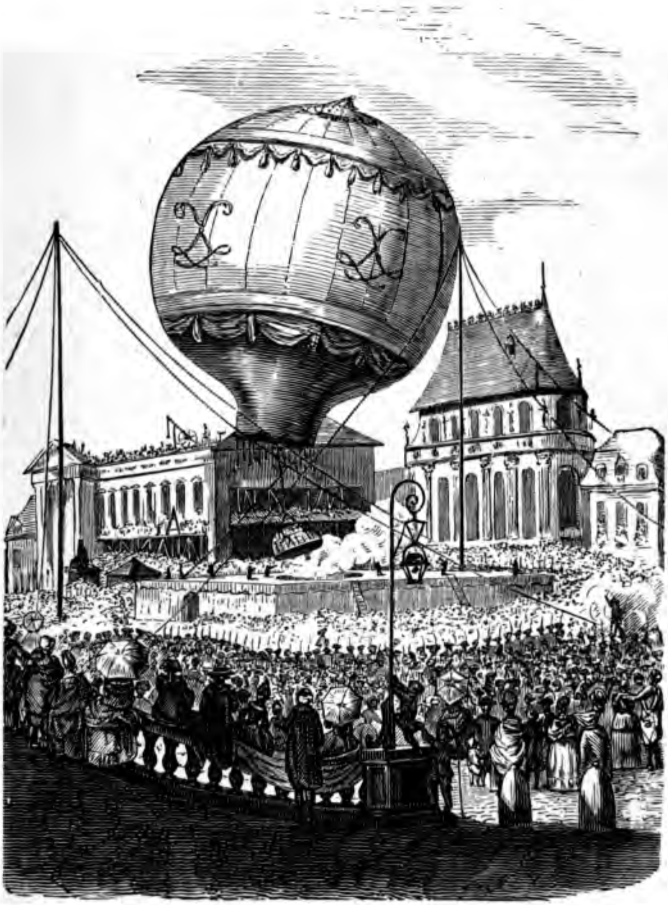
THE MONTGOLFIER BALLOON AT VERSAILLES.

NOT only was the birth of the balloon of the Champ de Mars publicly announced like that of the Dauphin, but it bore a paper containing an urgent request addressed in the name of science to those who might pick it up, praying them to send to Paris all information as to the manner in which it fell. But alas, the fall of the *Globe* occurred in the neighbourhood of the capital, and the peasants who saw it falling had no notion of what had taken place in the Champ de Mars: they knew nothing either of the philosopher Charles or of the paper-maker Montgolfier. They saw descending from the sky an enormous mass, which, if they might judge of its power from its dimensions, must be a redoubtable enemy. Moreover, the wind which was blowing caused the balloon to assume most eccentric movements. Twenty years later the peasants in other countries who witnessed such a sight flew before it. Not so, however, the bold country people of Gonesse; they approached the prodigy, and felt that it exhaled a fetid odour. This convinced them apparently that it must be an emissary of the arch-enemy of mankind, and they forthwith assailed it with showers of stones. It has even been reported that a chasseur fired at it.

Happily this ignorant onslaught did not prevent the experiment from teaching a valuable lesson. When Charles got hold of the envelope, he saw that there was a rent, which the peasants, who were present when the balloon came to earth, could not have made. This rent had been caused by the famous tap of which Charles had been so proud. Although the experiment was made at a spot scarcely a league from the tower of St. Jacques, Charles had forgotten the discovery of the great Pascal. He had shut the orifice, as if it had not been proved in Paris itself that the elasticity of the air diminishes in proportion as we rise into the higher atmospheric regions. At the surface of the earth the gas inside the balloon was in equilibrium, but higher up its volume so increased in proportion to the rarefied air as to cause the wire to cut the stuff which contained it. As soon as the rent was made the balloon fell. Since that time balloons have never been closed below. An orifice is made for the purpose of allowing the gas to escape in proportion as the pressure of the air diminishes.

To prevent scenes similar to that which took place at the fall of the *Globe*, the French government published an official notice in all the provinces. These circulars intimated that the Academy of Sciences had caused to be constructed at its own expense a large machine intended to perform before his Majesty the beautiful experiments of M. Montgolfier.

It must be confessed that this sage body was not very happy in the advice they gave to the inventor;



A MONTGOLFIER BALLOON SENT UP BEFORE LOUIS XVI. AT VERSAILLES.

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for the apparatus referred to, which was most elaborately ornamented, was composed of a canvas prism, covered over with strong paper, surmounted by a pyramid and terminated by a truncated cone. Happily it was thought advisable to make a trial of this elaborate structure in the garden of the paper-maker Reveillon, in the Faubourg St. Antoine. A few years later this generous patron of the montgolfieres (as fire-balloons came to be called) became one of the first victims of the French revolution. The montgolfiere of the Academy seems to have drawn on its devoted head the fury of the elements. The rain totally disfigured the ornaments, the paper peeled off in the most miserable fashion, and, to crown all, when an attempt was made to open the angles of the prism, the machine was torn, and thus rendered utterly useless.

But the decree had gone forth, and something must be done to be ready to exhibit before his Majesty at the time appointed, which was only two days after the above sad failure. In two days and two nights they managed to improvise a machine having a beautifully rounded form, for they had no time now for eccentricities. The experiment took place at the Court of Versailles on the 19th September, 1783, the day arranged for. Two astronomers only had been summoned. Both took up positions at the Observatory, Jeaurat on the terrace of the garden, and Le Gentil on the roof. A triangulation, in which the height of the building was taken as a base, proved that the montgolfiere reached a height of about 1500 feet. It descended gradually and fell in the wood of Vaucresson, after having gone a distance of only two miles. Suspended below the balloon, Mr. Glaisher tells us, in a cage, had been placed a sheep, a cock, and a duck, which were thus the first aerial travellers. They were quite uninjured, except the cock, which had its right wing hurt in consequence of a kick it had received from the sheep; but this took place before the ascent. Joseph Montgolfier's balloon rose much more slowly than that of Charles, although the dimensions of the latter were much less. As a result of this first comparative essay, the air-balloon won the day.

M. Charles was not the only notable professor of natural philosophy at that time in Paris. He had a rival in the person of a young native of Lorraine, born at Metz in 1756, and who lectured and experimented in the French Museum; this was Francis Pilâtre du Rosier, who was rather a daring experimenter. It is said that to prove the inflammability of hydrogen gas he drew it into his lungs, and then set fire to it as it issued from his mouth. It seemed to please him to frighten his audience by showing them that, like the dragon of the fable, he could breathe fire through his nostrils.

As soon as Joseph Montgolfier arrived in Paris Pilâtre made his acquaintance. He formed the project, then a really daring one, notwithstanding the successful adventure of the animals above mentioned, of attaching himself underneath a Montgolfier balloon. By profession a rival of Charles, Pilâtre was in every way an acceptable ally of the man whom Charles had got the better of. Montgolfier, in fact, had not enough of the devil in him to try the great unknown element. It was at once, then, arranged that Pilâtre should have charge of all the experimental part of the enterprise; he would be supplied with all that was required to make the great experiment. Pilâtre had the good sense to imitate Charles in the method he adopted for finding the necessary funds. He addressed himself to the public, that great anonymous Mæcenas, whose purse is never empty when his love of novelty and sensation is appealed to. Pilâtre had an engraving executed intended to serve as a souvenir of the glory of Montgolfier. Copies were sold at the sufficiently remunerative price of five shillings.

A great and very serious question, and one much discussed among the scientific worthies of the time, was whether it would be possible to breathe without risk such air as would be found at a certain distance from the earth. Only one means could be imagined of arriving at a solution of this vital point, and that was to send some animals aloft as pioneers and see if they came down alive. This was the reason that the sheep and his companions were attached to the montgolfiere at Versailles, with, as we have seen, a fortunate result.

CHAPTER V.

THE FIRST ASCENT.

In spite of the dissertations to which the voyage of the first montgolfiere gave rise, it was evident that Pilâtre might proceed with his preparations for the great experiment without any fear of a catastrophe. Montgolfier himself was ordered to come to Paris to hasten the work. The new machine, which was to be inflated in the gardens of Reveillon the paper-maker, was 46 feet in circumference and 66 feet in height, a form which montgolfieres have since retained. It was richly decorated with drawings of eagles and wreaths. A circular gallery, measuring 10 feet, was fixed by a multitude of cords. All around was a balustrade 3 feet 6 inches high, to prevent the occupant from turning giddy when he found himself suspended in mid air.

The simple announcement of the experiment produced great excitement. Notwithstanding the precautions of the police, there was a constant crowd beside Reveillon's garden. State dignitaries actually resorted to intrigues in order to gain admission to the place where such wonders were to be seen. Faujas de Saint-Fond has carefully preserved all the details concerning the preliminary experiments, which, intended originally to be made by a small committee, were transformed into ceremonious trials, and eagerly commented on by all classes of society and in all parts of the country.

On the 15th October, 1783, the preparations were completed, and Pilâtre made his first ascent in a captive balloon, that is, a balloon attached by ropes to the ground, and which therefore can only rise to a limited height. This one rose to a height of 80 feet. .Held by the cord which prevented the balloon from disappearing in space, as did that of the Champ de Mars, the car inclined in rather a dangerous fashion. It was thought that the weight of Pilâtre produced this effect. It was immediately attempted to restore the equilibrium by placing a weight on the other side of the gallery, and, thus ballasted, the balloon remained in the air for six minutes. Montgolfier's gas took six minutes to escape.

This would never suffice to make the circuit of the world, a project which had already been formed. It would be necessary, then, to carry into the air the furnace by which Montgolfier manufactured his gas if the balloon was to be of any use in discovering those southern lands which La Perouse was about to set out to explore. There was arranged in the middle of the lower opening of the balloon a chafing-dish of iron wire, suspended by chains. In this were placed straw and rags moistened with spirits of wine, to which Pilâtre set light before the eyes of the dismayed spectators. This bold and rash experiment was necessary in order that the balloon might remain in the air long enough to make a voyage of any length. The results were wonderful. The machine came down so gently that it was clear the descent could be regulated with perfect exactness. Accustomed to hazardous experiments, Pilâtre soon acquired a wonderful dexterity in the management of his aerial fire. Sometimes he would suddenly stop his descent; sometimes, on the other hand, he would allow himself to be rapidly borne to the ground. He had only to throw a few handfuls of straw into the dish to effect a fresh ascent.

Enraptured with the graceful and easy manner in which Pilâtre managed his chariot of fire, M. Giroud de la Villette asked to be allowed to accompany him. The two voyagers returned to earth without accident. The neophyte who had thus received the baptism of air was eagerly interrogated. He gave a most agreeable account of his impressions, and drew a charming picture of the sensations which he experienced during his aerial voyage. For what reason is not known, but M. Giroud de la Vilette showed no desire to accompany Pilâtre in his subsequent and much more adventurous journey. There was no lack of imitators, among whom we may notice the Marquis d'Arlandes, a gentleman of Languedoc, who asked permission from Pilâtre to mount the aerostat on the day when the great and decisive experiment was to be made. The favour was readily granted.

The preparatory experiments necessary to learn how to manage the machine were public events. The eyes of Paris, as we have already said, were fixed on the garden of the paper-maker, M. Reveillon. The roofs of the neighbouring houses were covered with spectators provided with telescopes, who took their places long before the arrival of the time for making the experiments. and stuck to their posts even after these were finished.

An unforeseen obstacle proceeding from the King himself failed to stop the course of events. Greatly inclined to favour the novel ideas, but exceedingly timid in science as in politics, Louis XVI. was averse to expose, to no purpose, precious lives in what would then seem a desperate experiment. He wished to form a transition between animals and man, and hit upon the idea of authorising the ascent on condition that it be executed by criminals condemned to death, who would be set at liberty in case of success. The virtuous indignation of Pilâtre deprived two criminals of the honour of being the first human beings launched into the aerial ocean. Pilâtre found at the court able and eloquent advocates who pleaded his cause energetically. An intelligent and influential lady, the Duchesse de Polignac, governess to the king's children, interested the queen in the cause of balloons, and Marie Antoinette, once gained over, Louis's scruples were soon removed. The Marquis d'Arlandes was included in the authorisation, or rather the passport which the King of France granted for the empire of the prince of the air.

It was on the 21st November, 1783, at the Château de la Muette, in the Bois de Boulogne, that this memorable ascent took place. The *Globe*, as the balloon was called, quitted the earth at abou 2 o'clock in the afternoon, and the wind, which this time was all that could be desired, showed the Parisians all the phases of an ascent which has had no analogy at any time nor in any country. The balloon, impelled toward the south-east, crossed the Seine and travelled toward St. Sulpice, passing between the École Militaire and the Hôtel des Invalides. Rather more than twenty minutes after its departure it descended in the meadows behind the garden of the Luxembourg. It had run about

FIRST ASCENT OF PILÂTRE.

9000 yards, with a speed considered enormous at a time when the steam locomotive had not been invented.

The official account of this brief but memorable voyage was signed by Benjamin Franklin. The Marquis d'Arlandes was entrusted with the task of writing a description of this first aerial voyage. The two aeronauts really rose to a very small height, only a few hundred yards, scarcely indeed beyond what may be called the suburbs of the earth. They floated in a region within hearing of all the noises of the surface, from which the eye can perceive all the features of the ground, from which men, though reduced to the size of insects, can be clearly enough seen. The houses, reduced to the proportion of Nuremberg toys, pretty and neat, appeared intended for the habitations of ants. Paris looked like a tiny model of a town, while the Seine, flowing in the midst of pleasant meadows, glanced under the least ray of sunlight. It would resemble a wonderful scarf of silk picked out with all the colours of the rainbow, and gilded by the rays of the setting sun. The narrative of the Marquis d'Arlandes, written simply and pleasantly, was received with something like disappointment by the public, who beheld the ascent with fear and trembling, and expected to hear of marvels and terrible experiences. The pleasant impressions of the Marquis d'Arlandes, with which everybody was disappointed, are however the uniform experience of all who ascend in balloons; they seem always to surprise readers who have not seen the earth gradually disappear and watched the insensible approach of the clouds.

CHAPTER VI.

THE REVENGE OF CHARLES.

The beautiful experiment of Pilâtre restored to the Montgolfiers all their popularity. The balloon of Charles was forgotten, unless he himself was bold enough to follow the example of Pilâtre, the first disciple of Montgolfier. Charles managed to obtain the favour of making an ascent from the Tuileries, a favour since then often asked, but always in vain. The king having placed the Tuileries at Charles's disposal, all the gates were closed and entrance forbidden, except to persons who had purchased the right of admission by payment of half-a-crown. The great pond was reserved for the inflation of the balloon; the water was not drawn off, but a platform was constructed in the centre. Opposite was arranged a large semicircular amphitheatre reserved for the princes, ministers, academical bodies, and subscribers to the *Caveau* Café; the last-mentioned patrons had indeed rendered more service to the aeronauts than the princes and the gentlemen of the Academy.

The car was of basket-work covered with cloth, painted in blue and gold. It was encircled with festoons of taffeta, each of which was bravely fastened by tassels of gold and cords of silk. The preparation of the gas and the casks which were to hold it, the pipes by which the hydrogen was to be introduced into the balloon, the very smallest article employed in the process, all were the objects of a feverish curiosity. The balloon was attached to the trees of the Grande Avenue, where it was balanced in the midst of a compact crowd who regarded it with mute wonder and admiration. But the Prince, who had refused permission to Pilâtre to make his venture, could not grant to Charles, without resistance, the right of leaving the solid earth.

On the morning of the experiment the police served Charles with a formal notice of interdiction. He was told that he must repair to the Prefecture, just as Pilâtre had to present himself at Versailles. He found there a functionary, the Baron de Breteuil, who had not the power of pronouncing any decision, but who promised to shut his eyes to the illegality of the deed that was about to be committed. The Baron, in fact, pretended not to see what was going on at the Tuileries in presence of a hundred thousand spectators.

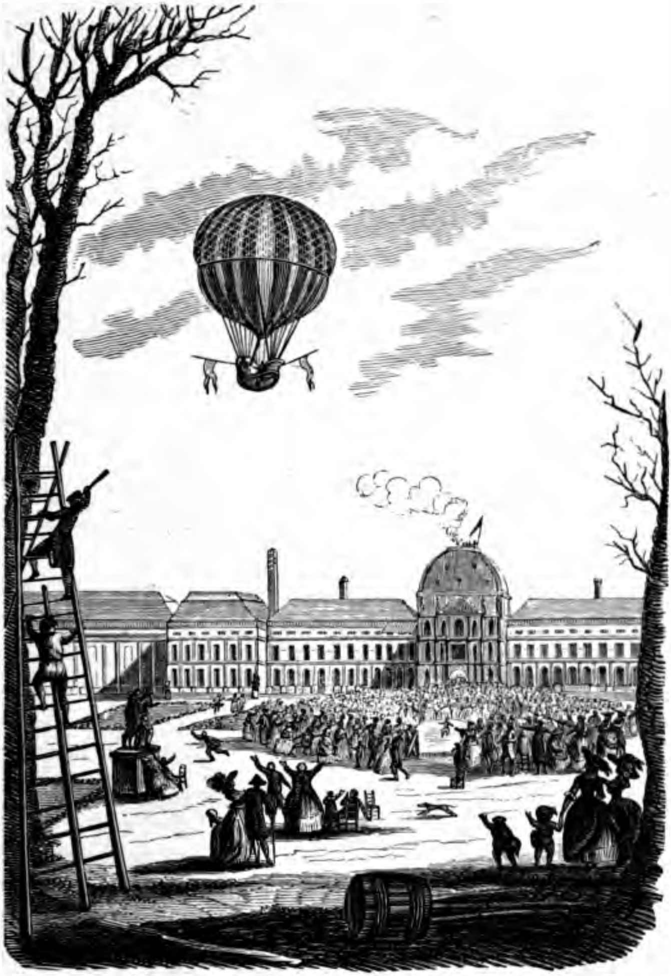
Had the Baron de Breteuil held vigorously to the letter of the orders of the King, there would have been something like an insurrection; for it is impossible to realise the excitement which these early balloon experiments produced in Paris. Aerial navigation has furnished many useful observations; it has, perhaps, more solid triumphs in store for the future, but we can never recall the juvenile emotions of those who were present at its birth in 1783.

People declared that Heaven had at last been opened to humanity. An old dowager is said to have burst into tears at the spectacle, and when asked the cause, " Alas ! " she said, " when they shall have discovered the means of escaping death, I shall not be here to take advantage of them."

The public of the Tuileries were greatly agitated by rumours, which are said to have been circulated by the partisans of Montgolfier. It was stated that one of the brothers Robert, who was to accompany Charles, had given up the project at the earnest prayer of his wife, who was ill; that the machine had been discovered to be dangerous, and that the experimenters had been arrested at the moment when they were about to start. It was only the departure of the balloon that could dissipate these clouds; but that was a sovereign specific.

Before mounting the car, Charles resolved to start on his voyage with a clear conscience, and therefore felt it necessary to make his peace with Montgolfier, who was present as an on-looker. Charles gracefully went up to his rival and requested him to cut the silken cord which held a pilot balloon to the earth. Was it not an acknowledgment that Montgolfier had really opened the aerial route, and some little reparation for his expulsion from the Champ de Mars ?

The balloon was 27 feet in diameter, and the car was suspended from a hoop surrounding its middle, and fastened to a net which covered the upper hemisphere. The ascensional power had been very nicely regulated and measured, so that on Decem-



ASCENT OF CHARLES FROM THE TUILERIES.

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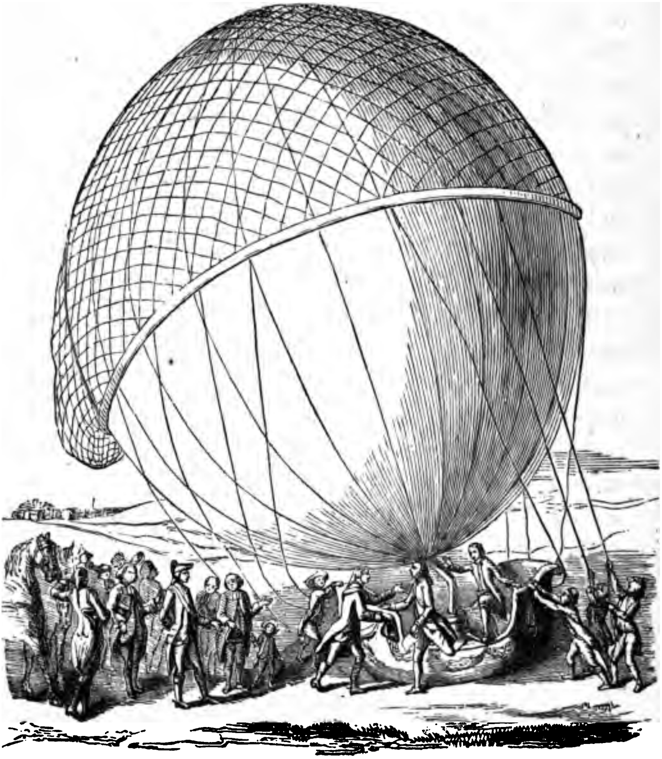
ber 1st, 1783, the balloon rose very gently from the Tuileries. The barometer, which was carefully observed, fell gradually to 27 inches, indicating a height of about 1880 feet. The temperature was agreeable, and the voyage, which lasted an hour and three quarters, altogether pleasant. After thus remaining more than four times longer in the air than their rivals, the aeronauts reached the earth in a field close to Nesle, a small town 27 miles from Paris. They had made four times the distance of the montgolfiere of La Muette.

Philippe Egalité, then Duc de Chartres, and M. de Fitz-James arrived at the moment when the voyagers came to ground. They signed a report or *procès-verbal* describing the principal circumstances of the descent. This is a formality which for a long time aeronauts never failed to perform, but which has fallen into disuse since ascents have become so frequent. This is to be regretted, since such reports brought together a great variety of information, which would in the long run have furnished a means of comparing the force and direction of the winds.

As the balloon when it reached the earth still contained a large quantity of gas, Charles took it into his head to ascend alone. But in the rapture of success, he forgot that he had lightened his car by leaving on the earth his companion, and that consequently he ought to have taken in some ballast to regulate his ascent. Instead of quitting the earth at a moderate speed, he shot into space with giddy rapidity. The impression of this wild journey was so lonely and disagreeable that Charles never again ascended in a balloon. He experienced, among other things, a violent pain in his right ear and jaw, no doubt due to the rapidity of his ascent.



DESCENT OF CHARLES.

It is probable that in this second ascent Charles reached in the space of a few minutes a height of

4300 yards—considerably more than two miles; a height which, without being dangerous, is quite sufficient to give to the aeronaut strange sensations, especially if he has arrived in those regions with the speed of an express train, rushing from the earth to the moon, and stopping at the first station. The movements of the balloon were so sudden and rapid that Charles took only twenty-five minutes to ascend and descend, and the horizontal distance traversed was twice or three times the vertical, although Charles descended only three miles from the place of ascent. This fact is no doubt to be explained by the variety of currents which he encountered in the higher regions.

The twenty-five minutes passed in the air in conditions so extraordinary, sufficed to give a material proof of the astonishing diversity of the directions of the different currents of air, of which meteorologists who stick to the ground cannot have any idea. Unfortunately, even in our own days, we do not realise all that might be learned from aerial experiences, if they were scientifically analysed and arranged in all their parts. Without any other effort than a little perseverance, we might come to be able to make use of the astonishing instability of the elements which undergo transformation before our eyes even when we remain on the surface of the earth, and which change with a fantastic rapidity when we live in the midst of them.

A saliant fact, and one full of instruction, in the physics or science of the air, received ample confirmation. The observations which De Saussure had made on the Col du Géant were brilliantly corroborated. Notwithstanding the shortness of his sojourn in the atmosphere, Charles established scientifically the rapid decrease of temperature; from 44½ degrees it fell to 25, or 7 degrees below freezing, after an ascent of ten minutes. As Charles forcibly remarked, ten minutes sufficed to pass from the heat of summer to the cold of winter. Gradual diminution of the pressure of the air, cold increasing with the height, a mixture of strata of air blowing in different directions; these three great physical facts were thus victoriously established in the very first year of the birth of balloons. These are facts which prove that, though balloons may not be of so much utility as enthusiasts maintain, yet they are capable of doing real service to science. We shall have occasion to point out other results due to their use. Without entering into the domain of hypothesis, for which every true aeronaut has a profound horror, we shall content ourselves with noting, as we go along, what we owe to balloons in spite of the neglect with which they have been treated during the last 92 years.

These early balloonists received much more attention and honour than generally do their successors of the present day. On December 3, 1783, Charles went to the Academy of Sciences to give an account of his aerial voyage. He was accompanied by Joseph Montgolfier. The president, Saron, who was in the chair, made the two guests sit by his side. Montgolfier, as the inventor, had the place of honour. When the account was finished, Montgolfier and

Charles retired. Meusnier proposed that these two gentlemen be appointed supernumerary members, a proposition supported by the president Saron. But certain members protested, remarking that this would be a dangerous precedent. It was to be feared that other inventors would force the door of the learned Academy by a mere stroke of genius. It was finally agreed to send to each of the two heroes of the meeting a piece of money, similar to that given to Academicians who are present at the weekly meeting, and moreover to send one each to MM. Robert, one to Pilâtre, and one to the Marquis d'Arlandes.

The discontent of the public was great when it came out that the Academy had been so shabby. The peace with England having just been signed, the King decided to treat them more magnificently, at least on paper. M. d'Angiviller, Director-General of Buildings, wrote to M. Charles announcing that the King intended to construct an obelisk in the centre of the Tuileries basin, the point from which the balloon set out. He ordered four well-known sculptors to send in plans in order that one might be selected without losing a day, so eager was the King. Louis XVI. moreover commanded the Baron de Breteuil to cause a medal to be struck at the Mint commemorating the date and the author of the discovery, which, he thought, was to immortalize his reign.

M. de Montgolfier received a patent of nobility for his father, and for himself the blue ribbon of the Order of the Holy Ghost; Charles a pension of 2000 livres, and Robert one of a hundred pistoles. A pension was also awarded to M. Pilâtre du Rosier, but he considering it too small, would not accept it. Passionately in love with aerial experiments, the daring aeronaut believed he would very soon oblige the government, by his additional labours, to award him a pension more adequate to the courage he had shown.

CHAPTER VII.

THE DEFEAT OF THE MONTGOLFIERES.

It seemed now as if the sky had become navigable, and man had nothing more to do than take possession of the immense domain. Paris set the fashion in ballooning, as she has done in many things more trivial. The honour of following the example of the capital fell to the second city of the kingdom, Lyons, which had naturally watched with a feverish interest the development of the invention of Montgolfier. The impatience was so great that the people of Lyons could not await the return of spring. The experiment took place on January 19, 1784. The *Flesselles*, the name of the balloon, a montgolfiere, was inflated with all due ceremony, and set out this time with seven persons in the car—viz. Joseph Montgolfier, Pilâtre du Rosier, the Count de Laurencin, the Count de Dampierre, Prince Charles de Ligne, the Count de Laport d'Anglefort, and M. Fontaine.

The *Flesselles* was probably one of the largest balloons on record, being 100 feet in diameter and about 130 feet high, and thus in shape almost round. The fire was kept up as before with trusses of straw, and the ascent must have appeared magnificent to those who looked on, but not to those who were in the car. The paper composing the balloon, doubtless too weak to resist the great pressure, split open, and the aerial journey ended in a compulsory descent, which, fortunately, was not attended by any kind of accident. The balloon was in the air only a quarter of an hour, and reached the height of 3000 feet. The aeronauts appeared in the evening at the theatre, where they received quite an ovation.

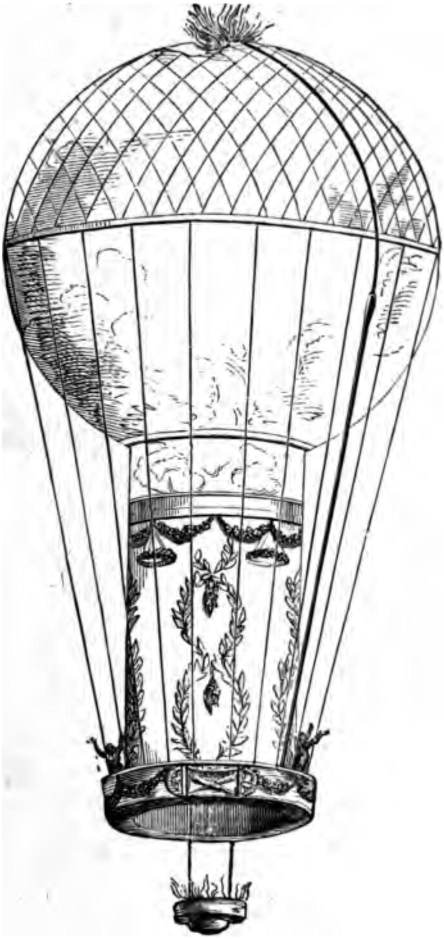
On the 4th of June following, Lyons witnessed another aerial ascent, which was rendered more attractive by the presence of a woman in the car. A young married lady of Lyons, Madame Thible, who it appears was very good-looking, was easily persuaded to take part in the aerial expedition. In the evening she was brought upon the stage of the theatre, where she was presented with a coronet of flowers amid the applause of the whole assembly.

Among the spectators of the ascent is said to have been the King of Sweden, who was travelling through France in transparent incognito. Gustavus seemed so delighted, that it was resolved to have another aeronautical exhibition as shortly as possible. On the 23rd of June, accordingly, he was present at the ascent of another montgolfiere, which was named the *Marie Antoinette,* and which started from Versailles, in the presence of the King and court. The machine was lavishly decorated. The ciphers of Louis and of Gustavus were artistically entwined. The diameter of the globe was, however, less than that of Lyons, being only 81 feet. The operations connected with this ascent were so difficult on account of the wind, that only Pilâtre and another could be persuaded to enter the car, and they had to keep up an unusually great heat to make the balloon rise and maintain itself in the air. After three quarters of an hour it descended, although the fire was yet as strong as ever. In falling upon an oak, the vessel containing the burning straw was upset, the tree was set on fire, and the *Marie Antoinette* soon became the prey of the flames. Pilâtre and his companion reached the earth thirty-six miles from the place from which they set out, between Chantrelles and Champlatreux. The Prince de Condé, who seems to have been owner of the place, immediately sent carriages to the assistance of his celestial guests, and is said to have given the name of Pilâtre du Rosier to the piece of ground on which the descent took place.

As a result of this ascent, Pilâtre received at last a pension of 2000 livres from the King. But Pilâtre had far higher and more noble aims. He was linked, in spite of himself, with the fortune of the Montgolfier balloons. He was not one of those aeronauts to whom balloons are only stepping-stones to honours and decorations. Ought not these wonderful machines, he seems to have asked himself, be made to serve some other purpose than that of mere theatrical representations in the open air? It was easy to see that an apparatus so fragile could not be manœuvred against the wind, though the burning of a little straw was sufficient to make it ascend or descend at will. Might not some means be discovered in the future of taking advantage of this valuable property to select any particular current of air? This idea seems to have struck the fertile imagination of Pilâtre, who conceived the bold project of combining the balloons of Montgolfier and Charles. The balloon of the latter would support the montgolfiere in the air, while the montgolfiere, with an insignificant quantity of fuel, could make the other ascend or descend at will. Thus associated with the air-balloon, he imagined the montgolfieres would be saved, and the aeronaut would be able to profit by the mutability of the winds to follow whatever line would lead him to his goal.

This was the kind of balloon which, in the hands of the Abbés Miollan and Jeannisset, inaugurated an interminable series of fruitless ascents. Constructed at great expense by the Paris Observatory, the machines of the two abbés were to carry them into the clouds. They commenced to inflate the air-balloon at midday, and at 5 P.M. it was still on the grass. The public, eager to witness a spectacle so extraordinary, became mad with fury that the ascent failed. The crowd rushed upon the fences, and penetrated even to the reserved space. There was a regular tumult in fact; the insurgents distributed among themselves the tatters of the balloon, and, as an appropriate finish-up, these Parisian wreckers set fire to the remains which they could not remove. The poor abbés slipped away as best they could. Some powerful friends spared them the misfortune of being sent to the Bastille to reflect on the dangers of rash ascents; but no one could protect them from the taunts which were showered upon them from all parts.

The balloon fever which seized the Parisians pro-



PILÂTRE'S AERO-MONTGOLFIERE.

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duced also a multitude of experiments with montgolfieres, which were set off with a sponge saturated with spirits of wine, to which light had been set. These engines, so cheap and easy to construct, kept owners of property from their sleep, for, falling at hazard, they might give rise to fires difficult to extinguish. Some means became absolutely necessary to put a stop to such dangerous sport. On May 1, 1784, appeared a police order forbidding the manufacture or setting-off of fire-balloons. It was, moreover, enacted that all aerostatic machines intended to be sent up, should be reported to the authorities, whose permission had to be obtained before the departure could take place. This permission would only be given to persons of recognised ability. Under a penalty of 500 livres, the day and hour on which the experiment was to be made had to be intimated.

This was a precaution, the wisdom of which must be admitted, but which soon fell into disuse on account of the difficulty of finding persons capable of appreciating the merit of aeronautic operations, and of giving an intelligent opinion upon their value. We shall have more than one occasion of showing, in what follows, how people, the most reasonable and even wise when they have to do with what passes on the earth, quite lose their heads when they have to do with balloons.

CHAPTER VIII.

THE FIRST CONTROLLABLE BALLOONS.

THOSE aeronauts who made use of the Montgolfier balloons did not attempt to do more than raise and maintain them in the air. The necessity of keeping up the fire, and of preventing it from setting light to the material of which the balloon was made, absorbed all their attention. It was different with those aeronauts who ascended in balloons that could, so to speak, look after themselves, and which had no other defect than that of rising too rapidly when a skilled hand had not the control of the ballast.

Hence the disciples of Charles were more difficult to satisfy than those of Montgolfier. For the latter, it was sufficient if they could simply sustain themselves, while the former, who had only to throw over a little ballast to lighten the balloon, and make up for the loss of gas, wished to use any disposable remaining force to make headway against the winds. The man who inaugurated these useful researches, had not awaited the invention of the Montgolfiers to study the application of mechanical science to aerial questions. Jean Pierre Blanchard was one of those dreamers who believe that they may overcome the force of gravity by imitations, more or less rude, of the models which nature has given us.

Born in 1753 at Les Andelys, of a poor family, and having received a defective education, he may be taken as a type of those restless spirits that abound in a great city like Paris, whose imagination is always raised to fever excitement by aerial matters. But notwithstanding the unflattering portrait of him which has been handed down to us, he was no ordinary man. From his sixteenth year he had shown a real aptitude for mechanics, having constructed of a vehicle that could be moved by human power; he was the inventor of a genuine velocipede—perhaps the first that ever was constructed. It was only after having given this proof of capacity that he devoted himself to the construction of an apparatus intended to imitate the flight of birds.

But if the scheme which he sought to realise was senseless, he set himself to work it out with considerable skill and wisdom. He was not so far left to himself as to jump from the terrace of St. Germains, as did an unfortunate workman who broke his thigh before he reached the Seine. He was not foolish enough to throw himself from a window to fall on a washing stage on the river side, as did a certain marquis of whom we shall speak by-and-by. Comprehending the difficulty of the problem which was before him, he devised a mode of experimenting which speaks strongly for his prudence. He did not attempt to leave the solid earth until after he had placed himself in equilibrium by means of a pulley and a counterpoise. When Charles made his ascent in an air balloon, Blanchard saw there was no more hope for anything heavier than air. He saw that it was the car of the aeronaut which must be fitted with the material for flying.

However simple an idea may be, it is not always understood by everybody. There are many people at the present day, not much gifted with sense, it is true, who still attempt to beat the air with bats wings, as if balloons had not been invented. Blanchard seized upon the new invention with something like arrogance. He audaciously announced that he would soon put an end to the rivalry between Charles and Montgolfier by eclipsing both, and he constructed a controllable balloon which he boldly called the "flying ship." He provided oars of great size, somewhat resembling wings, which he set in motion by means of a sort of mechanism that served to guide them.

The elements were not favourable to the ingenious Blanchard, who made his ascent from the Champ de Mars on March 2, 1784. It has been said that before quitting the earth the wind wished to give him some idea of the strength of the forces with which he had the hardihood to measure himself. Chance brought him an adventure which might have sufficed to disorganise a better equipped expedition. A pupil of the military school of Brienne took it into his head to ascend in the balloon in place of a priest who was to accompany Blanchard. Storymongers have attempted to make the incident more wonderful by giving the name of Napoleon Bonaparte to the rash youngster, but the newspapers of the day state plainly enough that his name was Dupont. As

Blanchard refused to admit this intruder, the young man drew his sword and made a great slash in the balloon. Dupont was removed by force, and Blanchard was obliged to set out all alone in a rent balloon.

ASCENT OF BLANCHARD FROM THE CHAMP DE MARS.

The first controllable balloon, which was 27 feet in diameter, had a strange form; all round the centre, or, as it is called, the equator, was a sort of cap or broad border of material intended to prevent a rapid fall, and which was therefore called a "parachute." One of the oars was broken before setting out in such a manner that it could not be worked from the very start; but that did not prevent Blanchard from maintaining with impertubable audacity that he directed the balloon. He descended at Bilancourt, near Sèvres, and as soon as he touched the ground he wrote to the papers a most ridiculous letter, in which he declared that he had annihilated both Charles and Montgolfier: if they had invented balloons, he had devised a method of towing them against the wind.

An attempt of another kind was made some weeks later by Louis Bernard Guyton de Morveau, at the expense of the Academy of Dijon, of which he was an influential member. Guyton, at one time Procureur Général, who had resigned the magistrate's office for the purpose of devoting himself entirely to science, was already celebrated over Europe for the discovery of the disinfecting power of chlorine, and by the establishment of a chemical nomenclature, at which he worked along with Lavoisier.

At the beginning of the year 1784, M. Thyrwaert, a Belgian chemist established at Liége, had devised a simple method for extracting a light gas from coal. It was the first time that an attempt had been made to prepare this substance, now of so much importance, and which owes, to some extent, its industrial birth to those balloons that many people affect to despise. Thyrwaert prepared his gas by introducing coal-dust into a gun-barrel. The opening was closed with sand, through which there issued a small tube, intended to collect the products of distillation. A balloon of the dimensions of those of the Baron Beaumanoir was inflated in the experimental room at Liége; it flew off in the presence of the Secretary of the Duc d'Aremberg, who published a certification of the fact in the newspapers of the day.

Guyton took up the Thyrwaert process, but upon a much larger scale. Instead of using gun-barrels crammed full of coal-dust, he filled with lumps of coal genuine cast-iron retorts, manufactured at the Creusot foundries. He extracted therefrom coal-gas in sufficient quantity to lead him to think of thus inflating a controllable balloon. Guyton tested the specific weights of gases obtained from a large number of substances, and gave the preference to that which is produced by the distillation of potatoes. If he decided to employ, like his predecessors, the inflammable gas produced by the action of acetic acid in zinc, it was simply in order to shorten his preliminary researches, and not to embarrass himself by the solution of side problems.

Although he was not a very skilled mechanician, Guyton did not allow himself to be taken in by the big talk of Blanchard. He thought that an experiment for controlling a round balloon was very unscientific, on account of the great friction of the air and of the small stability of the apparatus. However, he set himself to the construction of a spherical globe of 27 feet in diameter, having a capacity of 10,500 cubic feet, and a surface of 85 square feet. But in order to diminish the inconveniences of such a balloon, he added to his aerial car a sort of prow intended to cleave the air. As the screw applied to ships had not yet been invented, he had no choice as to methods of propulsion, and contented himself with oars; but he had the sense to make them very large, in order that the blade might act upon the air without the necessity of giving a great number of strokes per minute. His oars were of a size somewhat like those of the ancient galleys, though very much lighter; the handle was 30 feet long, and the blade had 25 square feet of surface. He had a second pair attached to the equator of his balloon, and which he intended to work by means of cords. A rudder, and a long pendant to show the direction of the wind completed the equipment of this interesting aerial machine, the construction of which gave proof of an intelligence which succeeding experimenters have been far from imitating.

The first ascent took place on April 25th, 1784. Unfortunately, a violent wind arose at the time of departure; one of the oars of the car got broken close to the handle, and the corresponding oar on the balloon itself was entangled in the cords and was thus rendered useless. The means of direction were thus paralysed on one side. Guyton's attention was, moreover, taken up with preventing the air from getting into the inside of the balloon. He had fitted the orifice with a valve opening of itself when the gas expanded, and closing automatically as soon as the excess of internal pressure diminished. Here was another cause of misfortune: when the gas wanted to get out, the springs refused to act and the balloon burst.

On the 24th of June a second and more fortunate experiment was made by means of funds collected by subscription. Guyton described the different evolutions of his balloon on this occasion with a wealth of detail and a clearness which leave no doubt of his good faith. Although the organs of propulsion were clumsy and imperfect, there is nothing extraordinary nor exaggerated in the movement which he declares he obtained. But the public is very suspicious on the question of directing balloons, and is only disposed to believe what it has seen and handled. The success of June 24th passed unseen.

Although deficient from a dynamical point of view, the first ascent of April 25th was not devoid of interest. Guyton had the honour of being the first to observe one of those optical phenomena so often seen from balloons. At 6 o'clock in the evening, the sun being six degrees above the horizon, the travellers saw a second brilliant sun six degrees above the other. This supplementary sun, produced by the image of the real sun, was reflected from the surface of a cloud as from a sheet of water so distinctly that one could scarcely perceive any difference in the intensity of light of the two. The mock or reflected sun, however, was composed of many concentric circles arranged on a ground of dazzling whiteness, and shades of colour like those of a vanishing rainbow.

A curious occurrence suggested to Guyton the idea of ascertaining the amount of heat which the sun might develop in the interior of a balloon. The balloon intended for the above experiment was inflated in an enclosure where it had been varnished, without any idea that the action of the sun might transform it into a fire-balloon. The heated gas expanded to such a degree that the swollen globe broke two of the cords which held it, and raised above the wall a young man who had charge of it. This unfortunate youth, who in order not to lose his hold had twisted one of the cords round his wrist, could not hold on longer, and the balloon, abandoned by its guardian, fell about 300 feet off. It was this incident which suggested to Guyton the idea of measuring the quantity of heat developed in the interior of the balloon. He found that the thermometer rose to 70 degrees, while in the open air it was only 59 degrees. This was a considerable excess, but did not reach the exaggerated figure which some aeronauts pretend to have found in recent years, as if the balloon were a huge lens and concentrated the rays which fell upon it.

A short time after, two other experiments in the same direction were made at Paris, in which two Princes of the Blood took part. The first of these two ascents was that of the elongated balloon of the brothers Robert, in the car of which was the Duc de Chartres; afterwards Philippe Egalité. The construction of this balloon was far from elegant: it was a sort of cylinder terminated by two spheres.

This turned out a deplorable experiment in every way. Here for the first time we come across an article which turns up afterwards more than once. The balloon of the brothers Robert contained inside a small balloon, which it was intended to inflate with bellows on regaining the region near the surface of the earth for the purpose of preserving the volume of the aerostat. This singular invention was the cause of disaster. The aeronauts had scarcely left the ground when they felt the necessity of getting rid of a globe of which no use whatever could be made; but in attempting to get hold of it they let it fall in so bungling a manner that it stopped the orifice left open for the escape of gas. Fearing an explosion, the Duc de Chartres took it upon him to make a hole in the balloon; some say he did it with his sword, others that he made use of one of the flags which the aeronauts waved for a short time in sight of an enthusiastic crowd. The crowd, indeed, around the car was so compact that the front ranks were obliged to kneel down in order to allow those behind to see all the details of the interesting spectacle.

A few days after, the youngest of the King's brothers, the Comte d'Artois, also made an ascent from Javel's manufactory. The balloon was magnificent, and was inflated with the greatest care, but the directing machinery was miserable; for MM. Alban and Vallet, directors of Javel's works (more accomplished chemists than mechanicians), had adorned it with the sails of a windmill. It was in such a Quixotic equipage that the Prince, who was afterwards to reign as Charles X., shot into the air for the first and last time.

The controllable balloons of 1784 thus served to prove by genuine experiment that balloons may be supported in the air, but at the same time they show that no human power is sufficient to battle with the wind. At that period scarcely any other motive power was known. The steam-engine had certainly been invented, but no means had then been discovered of making it move on rails, or sea, or river. Experiments in aerial direction had then to be abandoned until the time when the progress of mechanics would permit of a reasonable attempt being made at what, in 1784, could only lead to failure. Sixty-eight years were to elapse ere the next attempt was made to direct balloons by M. Henry Giffard.

CHAPTER IX.

SCIENCE AND BALLOONS.

The news of the great experiment at Annonay spread with the rapidity of lightning to all civilized countries. When it reached St. Petersburg, Euler, the great mathematician, was still alive, but was nearly eighty years old, and blind. One morning when some friends entered his room they found upon his slate a calculation to determine the height to which a balloon could rise in the atmosphere. Although old and blind and almost dying, he did not lose an hour in applying his algebra. This calculation was probably the last that one of the greatest mathematicians that ever lived made; three days after, September 7th, 1783, he died.

Euler's eldest son sent his father's calculations to the Paris Academy of Sciences, which published them in its volume for 1782, then being printed. But, alas, the example of the dying geometer has had few imitators; the mathematical theory of the motion of balloons is still much as he left it upon his slate.

While Guyton was carrying on his experiments, the great chemist, Lavoisier, did not remain indifferent to the great question of the day. He drew up a long and careful report, which was published in the name of the Paris Academy of Sciences, "on the advantages which may be derived from the invention of balloons." But, notwithstanding his zeal for the progress of science, Lavoisier was preceded in this work by the Abbé Bertholon, Professor of Physics at the Montpellier Academy, and one of the ablest experimenters of his day. In a remarkable work, Bertholon pointed out the facility with which balloons might be used to carry emissaries out of a besieged city. The first application of this method was not made till long after the great wars of the Republic and the Empire—viz., during the siege of Paris by the German army. Bertholon entered into details and calculations on the apparatus which Blanchard had attached to his flying ship. He stated that dogs and cats had already been let down from above the University of Montpellier by means of a parachute. An engineer officer had even made calculations to determine the diameter which should be given to the apparatus to enable a man to descend without danger from a great height. Joseph Montgolfier, who entered into correspondence with Bertholon, himself made some experiments, and gives many details on this subject. Yet we shall soon see Blanchard claiming the parachute as his invention, and the two brothers Garnerin attempting to wrest the honour from him, and then disputing between themselves as to who was the original inventor.

The Abbé Bertholon, who was actually investigating the subject of atmospheric electricity, immediately perceived, in connection with this, how much more useful balloons might be made than Franklin's famous kite; for kites could rise to only a very moderate height, while practically there was no limit to the height to which a balloon might go to draw off atmospheric electricity. Bertholon proposed to introduce into the rope which held the balloon a few threads of gold, which would conduct the electricity within reach of the operator. If the cord thus prepared were insulated by means of silk thread or in any other manner, the electrical fluid, to use a popular phrase, would often show itself in sparks. Not only should we thus discover the presence of electricity in the air, but besides we should be able to tell its species; we should have a true source of natural electricity, from which might ultimately be obtained the most powerful effects.

Charles made scarcely any experiment in this direction, although he constructed an apparatus which may still be seen at the Conservatoire des Arts et Métiers in Paris. Forty years later we will see the same ideas enounced anew by the famous Arago.

Bertholon was not less happy in the advice which he gave to aerial travellers for the conduct of their electrical investigations. "A physicist zealous for the progress of knowledge will rise by means of the balloon into the region of clouds; he will see atmospheric electricity originate and accumulate, the lightning being formed, spread itself out, leap from cloud to cloud, shooting beyond them, uniting and dividing them alternately, and driving them sometimes towards the earth. Those who have climbed high mountains have sometimes seen the lightning glancing under their feet; but what a satisfaction it must be to be in the midst of the clouds without having anything to dread. In fact, the balloonist, electrified by contact with the surrounding medium, will have nothing to fear from the thunderbolts of which he forms part."

The celebrated Horace Benedict de Saussure, who had already made a name to himself by his famous excursions upon the Alps, could not be indifferent to the discovery of balloons. He hastened to employ, with success, the process of the Abbé Bertholon to determine the electrical condition of the atmosphere more advantageously than by means of the flying kite of Franklin. He quickly perceived that the electric tension is positive in a placid sky, and that it increases with the elevation. Even in these advanced days we know very little more than this. It is to this eminent man of science that we owe a magnificent but simple experiment, which proves the radical fallacy of the theory of Montgolfier. He took a white-hot iron and introduced it into the interior of a balloon made of gold-beater's skin; the air thus strongly heated, expanded, and the balloon rose. It was scarcely possible to believe that from the hot iron any kind of gas had issued, or to refuse to admit that the ascent of the globe was a result of expansion produced by heat. There was no more talk after that of Montgolfier's "gas."

Only one man persevered in investigating the properties of the "gas" which proceeded from red-hot metals. This was the infamous revolutionist

Marat, who about this time exhibited great hostility to balloons, and attacked aeronauts with a bitterness unsurpassed even by the critics of recent years. His hatred was proclaimed in a manner that would have been comic, if he had not had the guillotine to back up his reasoning. Experiments made upon balloons were one of the grievances which he insisted on in his pamphlet, "Academic Charlatans," which brought about the arrest of Lavoisier. Pilâtre himself found no favour in the sight of this hideous monster; if he had not died in the field of honour, Marat would certainly have hastened his departure to another world.

CHAPTER X.

BALLOONS IN ENGLAND.

WHEN news of the experiments at Annonay and Paris reached England, the peace between that country and France was not yet signed, which may account for the delay of some months in the appearance of balloons on this side of the channel. But the English soon made up for lost time.

One authority states that the first balloon sent up in England was on November 25th, 1783, from the Artillery Ground in London, by Count Zambeccari, an Italian, who was soon to inscribe his name beside that of Pilâtre in the necrology of ballooning. This Italian's balloon was of oiled silk, 10 feet in diameter, and weighed 11 lbs. About three hours after it rose it descended at the village of Petworth, in Sussex, forty-eight miles from London. It was found to have been rent, like that of Gonesse, by the great tension of the gas, for which no means of escape had been provided.

During the course of 1784, several balloon ascents were made in England. Two of these were made from the Artillery Ground by another Italian, the Chevalier Vincent Lunardi, one of the best known names in connection with ballooning. The first, however, to make an ascent from British ground, according to Mr. Glaisher, one of the best authorities on ballooning, was Mr. J. Tytler, who ascended from the Comely Gardens, Edinburgh, on August 27th, 1784, in a fire-balloon of his own construction. He descended about half a mile from the place of ascent.

Tytler really preceded Lunardi by only a few days, and was altogether forgotten in the great success of the latter. The enthusiasm excited by Lunardi's experiment in London is astonishing and amusing to read of. His balloon was 102 feet in circumference, and was exposed to public view in the Lyceum, in the Strand, where it was visited by 20,000 people. The balloon was made of oiled silk, of which 520 yards were inserted in alternate strips of blue and red. The car was furnished with wings and oars, like large rockets, the former for the purpose of giving horizontal motion when becalmed, by agitating the air, and the latter to give up and down motion. Lunardi's first ascent was made from the Artillery Grounds, where the balloon was inflated with hydrogen gas, on September 15th, 1784. The ascent took place in the presence of the Prince of Wales and an enormous crowd of spectators. "He took up with him," Mr. Glaisher tells us, "a pigeon, a dog, and a cat, and the balloon was provided with oars, by means of which he hoped to raise or lower it at pleasure. Shortly after starting, the pigeon escaped, and one of the oars became broken, and fell to the ground. In about an hour and a half he descended at South Mimms, in Hertfordshire, and landed the cat, which had suffered from the cold. He then ascended again, and descended, after the lapse of three quarters of an hour, at Standon, near Ware, where he had great difficulty in inducing the peasants to come to his assistance; but at length a young woman, taking hold of one of the cords, urged the men to follow her example, which they then did." Lunardi at once "became the star of the hour. He was presented to the king, and was courted and flattered on all sides." A young lady, who saw the oar fall, thought it was Lunardi's body, and was so affected that she died in a few days. To make up for this, a jury, who were trying a prisoner for an offence for which the penalty was death, were so impatient to see the balloon ascent, that they acquitted the prisoner to save time. It is even stated that the King himself, who was in conference with his Ministers when the balloon was reported to be passing, broke up the council with the remark that they could resume their deliberations, but that perhaps they might not see Lunardi again. In 1785 Lunardi made several successful ascents from Kelso, Edinburgh, and Glasgow, and at a subsequent period in Italy, where he died, at Genoa, according to one account, in 1806, in a state of great poverty. In an ascent made from Edinburgh, in December, 1785, he fell into the sea about a mile and a half from shore, and was rescued by a fishing boat.

Another of these early ascents in England was also near ending in a tragedy. General Money, who made it, fell into the sea off the coast of Kent. A Dutch vessel which was in the neighbourhood when the involuntary descent was made, took to flight, and the General was saved by an English fisherman. The conduct of the Dutchman was vehemently censured. A print was published with an account of the incident, which stated that it was the first time that a Dutchman had refused to pick up *money*.

An air balloon, sent up at Sandwich, in Kent, on February 22nd, 1784, was found in the neighbourhood of Lille two hours and a half after; and in the month of March another, sent up at Canterbury, was picked up at Ypres. These two experiments proved to a certainty the possibility of crossing the Channel. The year 1784 was scarcely ended before the attempt was made.

On January 7th, 1785, at 1 P.M., Blanchard ascended in a balloon from Dover Castle. He had with him Dr. J. Jeffries, an American physician. Two hours after the time of ascent, the two reached the earth in the forest of Guînes. Twice while crossing the Channel the balloon descended, and, to save themselves, the aeronauts had to throw out everything in the car, and finally to strip themselves of their clothing. On the day after their arrival the two adventurers were splendidly fêted at Calais, and Blanchard was presented with the citizenship of the town in a box of gold. The municipal council asked permission to purchase the balloon, and to deposit it in the church, as a memorial of the experiment: the car may still be seen in the Museum of Calais. These honours were not the only ones which Blanchard obtained. A few days after, the fortunate aeronaut received a command to appear before His Majesty the King of France, who awarded him a pension of fifty pounds.

The Queen condescended to stake a sum on his behalf at cards. The courtier, who had the game in his hand, had the good taste to lose a pretty round sum, which was immediately handed over to "Don Quixote de la Mancha," as those who envied his good luck dubbed him.

Previous to this ascent, on October 16th, 1784, Blanchard had ascended from Little Chelsea with Mr. Sheldon, and having deposited the latter at Sunbury, rose again alone, and descended at Romney Marshes. Mr. James Sadler, sen., ascended from Oxford on November 12th, and is stated to have made two previous ascents, one on September 12th, in a fire balloon, and another on October 12th. On March 23rd, 1785, Count Zambeccari ascended from London with Admiral Vernon. He afterwards made several ascents in Italy, and, after escaping twice being drowned in the Adriatic, was at last thrown out of the car and killed in a descent on September 21st, 1812.

There are several interesting scientific experiments connected with the early history of ballooning in England, which it may be as well to refer to here. An unoccupied balloon, which had been sent up from near Matlock, was found by two peasants in the neighbourhood of Cheadle, in Staffordshire. Picking up thus in the fields a machine the form of which would naturally appear strange to them, for it resembled a half-inflated bladder, the two peasants were considerably embarrassed. It, however, occurred to them to carry it into one of their houses, where they got bellows and filled the balloon with air, in the hope that it would rise again. This seems a simple and ludicrous error, but one that has been repeated more than once in aerial annals. As these ignorant countrymen perceived that gas was issuing from an opening, which it made somewhat black, they lighted a candle and brought it near, in order to see better what was taking place. A tremendous explosion was of course the result. Four men were knocked down, the windows were shattered, and the house itself damaged. As to the experimenters, their beards and eyebrows were burnt, and they were fortunate in getting off without serious injury.

Soon after, an intelligent inventor conceived the idea of utilising this explosive property. On December 26th, 1784, there took place at Windsor the explosion of the first balloon designed to serve as a petard. The event is described in a letter from the celebrated James Watt to one of his friends in Birmingham. Mr. Boulton, the inventor of the process, and whose name is linked with that of Watt in connection with the steam-engine, constructed a balloon of fine paper, and varnished it. It was nearly 5 feet in diameter, and was filled with one part of atmospheric air to two parts of hydrogen gas. Underneath was fixed an ordinary fusee, attached to a match about 2 feet in length; this was lit before the balloon was let off. The explosion occurred six minutes after the departure, and, as the wind was strong, the balloon had already gone two miles. The persons near at the time of the explosion, heard, Watt tells us, a noise like that of thunder.

CHAPTER XI.

THE FIRST AERIAL WRECK.

BLANCHARD having succeeded in crossing the Channel, a restless spirit like Pilâtre could not remain a mere spectator of such an achievement; he immediately decided to solve the same problem, but in an opposite direction, crossing from France to England.

It was already known that the winds which come from the west are much more frequent and steady than those which blow from the east, and that consequently the chances of Pilâtre succeeding were less than those of his fortunate rival. Moreover, had Blanchard missed France by a west wind, he had before him all the Continent of Europe, while Pilâtre, should he go astray, might be drawn direct northwards. He was liable to be lost in the icy ocean, if his voyage lasted long enough.

Pilâtre quite understood the natural difficulty he had to overcome, but he hoped to reach the end of his journey by means of a contrivance which he had devised to enable him to accomplish his great scheme, and the purpose of which was to combine the properties of the montgolfiere with those of the air balloon. A fire balloon 10 feet in diameter, was placed underneath an air balloon 37 feet in diameter.

Being thus enabled to mount to any height by burning a little straw, Pilâtre hoped to fall in with a current of air which would carry him in the direction of Britain, even when the lower winds were adverse.

This was a seductive means of taking advantage of the various currents of air, already tried by M. Charles. But to dare thus to combine fire and gas, Pilâtre must have forgotten even the name by which hydrogen was then known—inflammable air. Charles had good grounds for criticising the project of his rival, who had the temerity, he said with justice, "to light his fire beside his powder magazine."

Notwithstanding this objection, and the little confidence which people now had in the attempts at guidance, the French Government placed at the disposal of Pilâtre a sum of 1600*l.* The preparations were thwarted by a multitude of difficulties which kept constantly cropping up. Winds blowing obstinately from the west seemed in league with the numerous enemies of the venturesome aeronaut who was about to give himself up to their caprices. M. de Calonne, Controller of the Finances, was irritated, and reproached Pilâtre in brutal and unmerited terms.

It was only on June 15th, 1785, at seven o'clock in the morning, that Pilâtre set off in a battered balloon, which allowed the gas to escape at all points. After being up for about half an hour, and when at a height of probably 3000 feet, the balloon exploded. The unfortunate aeronaut was precipitated to the ground, along with Romain, a young workman who, having helped Pilâtre in the work of construction, had obtained the favour of accompanying him. Romain still breathed, but soon expired. As for Pilâtre, he never stirred, and his body was dreadfully mutilated.

Pilâtre may have had some presentiment of his sad fate, for he refused to take with him the Marquis de Maisonfort, who had thrown a roll of 200 louis into the car to induce Pilâtre to take him. Pilâtre had shown remarkable determination to carry out his experiment. Three times did he come to Boulogne, and three times did he commence the inflation, when he was compelled to stop. At last, when the time of departure came, "the experiment is too uncertain to risk the life of another," he said to the man who was to tell the story of the terrible adventure; a saying which the framers of theories should never forget.

This catastrophe is altogether a sad one. The fall of the first martyrs to aeronautical science occurred at the foot of the column which had been erected to the glory of Blanchard, the aeronaut whose exploits they had wished to excel. Pilâtre had met at Boulogne a young English lady, a boarder in a convent in the town, to which she had gone to finish her education. The two were to have been married after the conclusion of the experiment which ended so sadly.

Although badly contrived and imprudent, the experiment of Pilâtre must not be classed with any of those numerous burlesque experiments and chimerical projects to which ballooning has given rise.

We shall not dwell more than is necessary in the course of this work on enterprises often undertaken to throw discredit upon aeronauts, for unfortunately the public is always inclined to draw general conclusions from a very narrow basis of fact. But whatever may have been the mistakes of individuals, they cannot diminish the fascination belonging to voyages in the clouds. The folly of inventors cannot poison the air nor destroy the charm which takes possession of the aeronaut when he perceives from the vantage-ground of his car a corner of the infinite, as a ray from the glory of God.

CHAPTER XII.

THE REIGN OF BLANCHARD.

BLANCHARD very soon returned to England to enjoy the popularity which the success of his Channel ascent had gained him. But as his experiments in the guidance of balloons had failed, it was necessary that he should add a new attraction to his flying vessel; he therefore got two young ladies, named Simonnet, to ascend in his car. Fearing that the interest excited by the courage of his companions would soon be effaced, he thought to profit by the experiment at Montpellier, and threw down from his car dogs, cats, and even sheep. He commenced with his dog, which satisfied him for a long time. This animal soon became as celebrated as his master. But notwithstanding these attractions added to his performances, Blanchard failed to find everywhere a sympathetic support. If he reigned for some years over spectators eager for sensation, his subjects revolted more than once.

On his return to the Continent, Blanchard commenced a trial of his power with the inhabitants of the Hague. He announced by sensational advertisement a great experiment in which he would be accompanied by four voyagers. But the vicissitudes of the time—perhaps some defect in the sewing or the varnish, or a too hurried manufacture of the gas—prevented the adventurous aeronaut from keeping his promise: he was able to take with him only a single companion. His misfortune did not end here. The wind having driven him towards the sea, he had in all haste to open the valve and descend upon a meadow, only a few leagues from the incensed spectators. Poor Blanchard soon found in this field an echo of the angry voice which growled around his car before he set out. The proprietor of the ground, evidently an accomplished speculator, demanded an indemnity of ten ducats for the use of the space which the balloon occupied while it was being emptied of gas. The peasants, who collected from all parts with pitchforks and sticks, took a noisy part on behalf of their neighbour. They broke up the car, and carried off as a trophy the gilt gauze, as also the cloth with which it was covered. Quite subdued, Blanchard had to pay and to pretend that he was satisfied. Turning his back upon ungrateful Holland, Blanchard returned to France, where he received warm support and universal sympathy. He went by the forest of Guînes, where he was recognised and led in procession to where the column which bore his name had just been finished.

Blanchard, full of pride and self-conceit (qualities which aeronauts have in common with other men), was keenly sensitive to all the attacks which jealous pens directed against him. When he found himself in front of the little monument intended to celebrate his achievement, he took his pencil, measured the diameter and height of the pedestal, and silently reckoned them up. "Gentlemen," he cried, "I shall no longer fear, thanks to you, abuse and calumny. It will take fifty thousand reams of libels to cover all the sides of the column which you have erected to me."

Although Lille was not far from Calais, Blanchard found the inhabitants of the capital of French Flanders of much the same temper as those of the Hague. As the wind was too strong for the balloon to be inflated, Blanchard refused to fulfil the promises of the advertisement. The public, which rarely listens to reason in such matters, was irritated; Blanchard was mobbed. He would, perhaps, have been as cruelly treated by the people of Lille, as Orpheus is said to have been by the Bacchantes, had the magistrates not sworn that they would keep him in prison and that he would not leave Lille unless by means of his balloon. Next day the wind had fallen, and Blanchard ascended as M. the Mayor had promised. The ill-will was changed into indescribable enthusiasm when Blanchard was seen to detach from his car a parachute; his glory was at its height when it was ascertained that this parachute carried quietly from the clouds the aeronaut's dog, and when anyone could caress at his pleasure an animal which had accomplished so perilous a leap.

This experiment with the dog was repeated some days later at Frankfort, in presence of a greater crowd than was ever seen at the coronation of any German Kaiser. Blanchard, besides his dog, had taken in his car the Prince of Hesse-Darmstadt, and an officer of dragoons. The ascent and progress was very rapid, for in thirty-three minutes the balloon had run a distance of fourteen leagues. The three human adventurers returned immediately to Frankfort, where the people awaited them, and where they met with a reception almost delirious. Count Romanoff, the Russian Ambassador, led Blanchard to the balcony; this grave diplomatist carried a torch in each hand in order that the countenance of the prince of aeronauts might be better seen. Men yoked themselves to the carriage in which he was drawn to the theatre; he was led from box to box in order that he might receive congratulations. His bust was placed upon a throne erected in the midst of the temple of memory, and around his temples was twined a branch of laurel. Three actresses representing the Graces, escorted by children dressed as Cupids, went to crown him in his box, after having sung some verses composed in his honour.

Three days before, this same people threatened to stone him because a gust of wind opened his balloon just as he was entering the car. Their fury was so great that Blanchard fainted, and if the Duc de Deux-Ponts had not borne him off in his carriage, the unfortunate aeronaut would have been torn to pieces. A more striking example of popular fickleness is not on record.

Blanchard received innumerable snuff-boxes, gold-boxes, medals, etc., etc. At last, twelve princes and princesses of the Holy Roman Empire, who happened to be at Frankfort, subscribed a sum sufficient for the construction of a great balloon, intended to figure in the fête given on the occasion of the coronation of the new Emperor. The balloon was to be of power sufficient to raise sixty persons at one time, but history does not say why its construction was not even begun.

On November 19th, 1785, Blanchard made an ascent at Ghent, in which he was exposed to great dangers. Forgetting what happened to Charles, he allowed his balloon to acquire a great ascending force, and he shot like an arrow right up into the air. He was immediately attacked by the cold which prevailed in the region to which he so rapidly penetrated. Feeling that he would not be able to seize the cord of the valve and keep it open long enough to allow the superfluous gas to escape, so quickly had he been paralysed by the cold, he took a resolution which may be called heroic, for without hesitation, and swift as lightning, he ripped open his balloon. Immediately the globe descended at a furious rate, and reaching a more genial part of the atmosphere, Blanchard came to himself, and saw at once the tremendous risk he ran: the fall would prove fatal. A few seconds more and Blanchard would have met with the fate of Pilâtre; but he darted into the circle which held the netting, the car struck the earth before him, broke his fall, and saved his life.

In the account which he published of his ascent, Blanchard stated that he reached the height of 32,000 feet—nearly six miles. The astronomer Lalande forthwith publicly declared that there must be some mistake in these numbers, and that no one could ascend to so great a height without being at once asphyxiated, if he were not frozen to death. Blanchard's only reply was to publish in the Lille journal a letter in which he challenged his opponent to accompany him in his aerial flights. It took thirteen years before Lalande could decide to accept the challenge which Blanchard gave him.

From this time to the outbreak of the French Revolution, Blanchard made a number of ascents which it would take too long to refer to in detail, and which, although accompanied by instructive accidents, scarcely contributed anything to the progress of aerial navigation. The experiment which really brought Blanchard popularity and wealth was, we have no doubt, the descent in a parachute performed by his dog, sometimes even by a sheep. It did not occur to him to introduce the monkey, which has played a part in aeronautics only in quite recent times.

It was Blanchard who conceived the original, but not very happy idea of stringing together a group of balloons. The origin of what were afterwards known as "aerial flotillas" must be connected with the ascent of May 27th, 1787, from Valenciennes, when Blanchard was raised in a car supported by a cluster of very small balloons.

One of the most curious circumstances in the career of this cosmopolitan balloonist (for he passed a great part of his life abroad) was the pains which certain despotic sovereigns thought themselves compelled to take in order to conceal their hostility.

The Emperor Joseph of Austria, who prided himself on his philosophy, when asked by Blanchard for permission to make an ascent in Austria, slily replied, that not only would he grant it with pleasure, but also requested Blanchard to appear before him and show how the utility of balloons could be demonstrated. The King of Prussia was more outspoken but quite as double-faced; he replied that notwithstanding the well-known ability of the aeronaut, he could never be sure of his fate, and that if misfortune should happen to him, the King did not wish it to occur on his territory. The real motive of these interdictions, it is believed, was the fear that the mania for balloons tended to encourage the spread of republican principles. Indeed, when the revolutionary wars broke out, poor Blanchard, who was then in the Tyrol, was arrested under some weak pretext and thrown into the dungeon of a fortress, without any plausible reason being given for treatment so rigorous. He was accused of trying to spread Red Republican principles. Nothing could have been more unjust, for Blanchard, strictly speaking, had no political opinions. On his release from prison he retired to America.

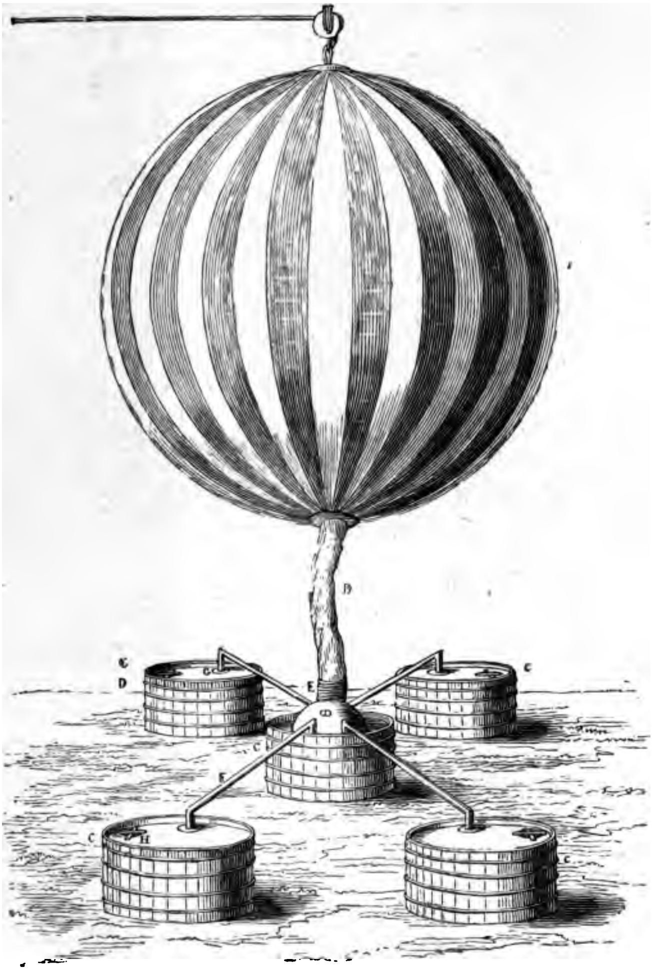
CHAPTER XIII.

BALLOONS AND THE FIRST FRENCH REPUBLIC.

ONE of the first acts of the Committee of Public Safety, established in France after the execution of the unfortunate Louis XVI. by the Revolutionists, in 1793, was to form a scientific committee for the purpose of stimulating the genius of inventors. Guyton, who as we have seen took up the aeronautic question with zeal in the year 1784, could not forget balloons. If the experiments in aerial direction had been a genuine success, he would have proposed to organise a flotilla for the purpose of carrying fire and sword into the country of the enemy, and of setting fire to Berlin. He would have sought to give to the French the empire of the air, which would have rendered useless all the sailors and all the fleets of "perfide Albion," who was then, and for long after, considered France's greatest enemy. But having the good sense to restrict his ambition to what was immediately practicable, he offered to the Committee of Public Safety to organise captive balloons for the use of armies in the field, and which, though infinitely less useful—for balloons that could be guided would have ended the war at a single stroke—would yet render most valuable services to the armies organised by the National Convention, as the governing power of France was then called. Such balloons could be used both in the defence and attack of fortified places, and in assisting and directing the movements of armies in the field, and might well inspire the French soldiers with the idea that they would thenceforth be unconquerable.

The Committee of Public Safety eagerly gave their approbation, on condition that the gas necessary to inflate the balloons should be prepared without sulphuric acid, in order not to interfere with the supply of powder by consuming a certain quantity of sulphur. Guyton de Morveau was thus compelled to investigate thoroughly the process of manufacturing hydrogen by means of the decomposition of the vapour of super-heated water. The apparatus for the purpose was exceedingly simple, and the preliminary trials, made at the inflation of the aerostat of Dijon, supplied the principal elements. The water to be decomposed came from an upper reservoir by a pipe provided with a cock to regulate the supply. It was vaporised naturally, and the vapour or steam, forced by the natural pressure of the liquid, fell upon the red-hot metal, and was decomposed as soon as it came into contact with it. The oxide formed by the oxygen contained in the water, remained on the metal, and the hydrogen issued by a second orifice, mixed with more or less of the water which had not been decomposed.

Unfortunately, the weight of hydrogen contained in water is very small. To fill a balloon capable of raising a man it was necessary to oxidise enormous



INFLATION WITH PURE HYDROGEN IN THE EIGHTEENTH CENTURY.

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masses of metal, and the result was that, notwithstanding the low price of iron filings, the process turned out to be most expensive. But Guyton had the good fortune to find the help he was in need of from a student who had attended the lectures of Charles—Captain Coutelle. He had been tutor to the Count d'Artois, and although he was over fifty years of age, he had preserved the fire of youth and, at the same time the stiffness of his pedagogic profession, which was rather an advantage in the direction of such extremely delicate manipulations.

The preliminary experiments took place at Paris under the eyes of the Scientific Committee. As soon as about 18,000 cubic feet of gas was prepared, Coutelle was sent off to General Jourdain, who commanded at Maubeuge, to learn if he would consent to the necessary material for the inflation of the balloon being sent from Paris. Coutelle arrived at the moment when General Chasal had been arrested for being involved in a plot to deliver the place to the enemy. Jourdain, whose scientific education had been somewhat neglected, did not at first comprehend the proposals which the Committee of Public Safety had sent him, and he threatened to shoot the innocent Coutelle as a spy. But he softened down when he saw that Coutelle was not in the least disconcerted, and ended by congratulating him on his zeal in the defence of his country. He even accepted with pleasure the proposals of the Committee, but on condition that experiments should not be made in a place so closely besieged as Maubeuge, and that the apparatus of which Coutelle spoke should be first tried at Paris.

The first inflation was thus made under the eyes of the War Committee, in the Salle des Maréchaux. The furnace for the decomposition of the water was erected on the terrace of the Feuillants. The experiments were continued in the Place de la Concorde, then in the old Château of Meudon—a large building situated on the terrace, and where the War Committee carried out all their experiments.

The first captive ascents were made in presence of the Committee, with two ropes, in case one should break; it was impossible to imagine that a single bullet could cut the two cords at one time. Coutelle was required to take his place in the car of the balloon, and to mount in presence of the Committee to a height double or treble that which Pilâtre had reached in the gardens of Réveillon. They gave him, moreover, a number of signals to repeat, and observations to execute.

Coutelle ascended to the entire extent of the ropes —not less than 1600 feet above the terrace—equal to about 2100 feet above the level of the river Seine. A great difficulty against which aerial observers have to contend when they reach such heights, is the multitude of objects which is presented to their eyes. They require to be possessed of very considerable experience to discover what they are in search of in the midst of such confusion. However, water-courses are of great assistance to them, for these cannot escape the most agitated observer. By means of a telescope, Coutelle was able to distinguish, with the greatest accuracy, all the windings of the Seine as far as Meulan, at the distance of sixteen miles. A district embracing a surface of 1100 square miles, equal to a hemisphere of the small planet Juno, lay extended at his feet.

Recalled to the ground after having exchanged a number of signals with those below, Coutelle received warm congratulations. He did not conceal the terrible impression which the balloonist experiences in spite of himself, when he finds himself alone in the car in presence of immensity; for the cord which holds the car to the ground guides his eye, and impresses him with an overpowering sense of his insignificance. Coutelle insisted that the officer intrusted with the observations should always have an assistant in the car with him, in order that he might be able to bear up against this feeling.

Next day Coutelle hastened off to the army of the north, where Jourdain would receive him without difficulty, now that the conditions he imposed were complied with. It was decided, moreover, to create at Meudon a permanent establishment, the command of which would be entrusted to the young Conté. Like many notable men of that epoch, the commandant of the Aeronautical School was the son of poor peasants. He was born in the neighbourhood of Séez, a small town in the Department of Orne, where the clergy were then very rich and powerful. Some ecclesiastics, taking a fancy to him, undertook the care of his education, which was scarcely completed when the great experiment of Montgolfier fired his enthusiasm. Two years later, .Dufriche-Valazé, a celebrated advocate of Alençon, who subsequently played a prominent part in the French National Assembly, took it into his head to send up a balloon; he failed in the attempt, but the young Conté, who was possessed of great ingenuity, undertook to execute it, and with complete success. Brought into notice by this lucky chance, Conté obtained the means of continuing his education.

Before setting out for Meudon, Coutelle tried a second inflation in the Place de la Concorde. Conté, who happened to pass near when the operation was going on, found the processes defective. "What a tremendous expense," he cried, "to obtain so small a result!" At that eventful period in France, everybody was more or less of a policeman. A passer-by, who had heard the exclamation, followed Conté, discovered the house where he lived, ascertained his name, and reported the circumstances to the celebrated Carnot. The latter immediately sent for the young man, questioned him, and gave him a post in connection with the inflation of balloons. Such was the origin of the scientific fortune of a man of whom the great Napoleon could say with justice, that he had all the sciences in his head, and all the arts at his finger-ends.

CHAPTER XIV.

THE FIRST COMPANY OF MILITARY BALLOONISTS.

THE military balloonists were assimilated to the military engineers in the matters of dress and discipline. The only difference consisted in copper buttons, on which was engraved the figure of a balloon. The company consisted of only fifty men, a number insufficient in certain cases for the manœuvring of a balloon; but the captain had the power of recruiting by compulsion from all the regiments in the army, when the process of inflation required it, or when he wanted additional hands to resist the wind. The effective was mostly composed of lawyers, merchants, clerks, and students, all proud of their position as aeronauts, for the glory of Pilâtre and Montgolfier was reflected upon the humblest soldier bearing the sacred buttons.

The corps contained in its ranks some rather singular individuals. There was a former priest of Montmorency, whom the Reign of Terror had driven to take refuge in the camp, but who only waited the advent of more peaceable times to resume his cassock. We must also mention Selles de Beauchamp, who entered the corps under the name of Cavalier Albert, rose to the rank of officer, and left interesting memoirs on the adventures of military balloonists. The father of Beauchamp, an officer in one of the royal regiments, was seriously wounded in Piedmont, where two of his brothers were killed. He retired, moreover, and died in 1781, leaving a child six years old, who, two years later, lost his mother also. As an orphan of fortune, as soon as he was old enough, he was sent to the Harcourt College, where he was treated as a youth of quality. His tutor adopted zealously the revolutionary cause, while Beauchamp stuck to the Court party. The latter in attempting to leave the country, was arrested and sent to the army of the Loire; but rather than join it, he engaged among the military balloonists, of whose life and adventures but for him we should have known nothing, for the memoirs of Coutelle, though very valuable from a scientific point of view, are very laconic, and enter into no details.

To all these elements Coutelle added a certain number of mechanics, whose services were indispensable. His first lieutenant, Delaunay, was formerly a master mason, particularly useful in the construction of furnaces. This operation was of the greatest importance for the military balloonists, for it required no less than 12,000 bricks to build the reverberating furnace for the manufacture of the hydrogen gas. It was fitted with seven cast-iron tubes, which had been made at Creuzot. To keep these tubes in working order required the greatest care and watchfulness, and when anything went wrong, it cost the inexperienced soldiers many a burnt finger to put it right.

The process of inflation lasted from 36 to 40 hours, during which the balloonists took scarcely any sleep, as the fire had to be kept constantly burning. The balloon, which thus cost so much trouble to fill, raised two persons to the height of only 1650 feet, with a weight of ballast about equal to their own, and which served to regulate the ascent. This was thrown out as the balloon rose, so as to counteract the weight of the cable, which, of course, gradually increased in weight as it was unrolled. The duty of the soldiers was confined to holding the ropes; it was only the officers who had the right of ascending in the car.

The Austrian and Dutch troops who besieged Maubeuge were not sufficiently numerous to completely invest the place. The balloon, which had been lashed to an artillery carriage, along with the apparatus for inflation, could thus easily enter the place from the French side. The furnaces were established in the college court, and a few days after its arrival the *Entreprenant*, as the balloon was named, was inflated without the enemy being able to make out the design of the extraordinary spectacle which presented itself. The first ascent was made amid the thunder of cannon and the "hurrahs" of the garrison. If we may believe the report made after the descent by the engineer officer who accompanied Captain Coutelle, it was impossible for the enemy to make a single movement without every detail becoming known. The officer pretended even to have been able to count the number of panes in the windows of houses at a distance of fifteen miles. This is possible enough, no doubt, in very clear weather, though we are inclined to believe the officer in this case was exaggerating.

The moral effect produced in the Austrian camp by this spectacle, so novel and unexpected, was immense. The commanders soon perceived that their soldiers believed they had to deal with sorcerers. To combat this dangerous opinion, and to restore their courage, the general resolved to destroy, at any cost, this fatal machine. As soon as they found out that it rose each day behind the same breastwork and above the same spot, they caused two four-pounders to be placed in a hollow. One morning when the balloon ascended majestically into the air, a ball passed above the envelope and fell in the French entrenched camp. Immediately another bullet grazed the bottom of the car, in which was Coutelle. The enemy were evidently confident of hitting the balloon. The Captain showed himself, saluted, and cried, "Vive la République!" He then gave the signal to continue the ascent, and the balloon was soon beyond the range of the cannon. The enemy had devised some other means of defeating the purpose of these aerial spies, but these became unnecessary, as no more ascents were made.

To reward the balloonists, they were allowed to give a ball to the ladies of the town, which turned out a great success. Indeed, the favour of the ladies followed the balloonists wherever they went, which was not an unmixed blessing, and seems in the end to have contributed to the suppression of the corps.

In order to be able to carry about the *Entreprenant* from place to place along with the army, without emptying it of its gas, it was necessary to devise some convenient means of transport. This was done by Coutelle. To the equator of the balloon was attached twenty moveable claws, or hooks, by means of a running knot. To each of these was attached a cord, which a balloonist held at his belt, and which he could let go at the first signal. The Captain took his place in the car, which was kept at a height sufficient to allow the cavalry and the military equipages to pass underneath, for it was necessary that the balloon should in no way be a hindrance on the march.

As the *Entreprenant* could raise a weight of 500 pounds, Coutelle took advantage of this to stow away in the car the ropes used in the ascent, the stakes for encampment, the hammers for driving them in the ground, the signals, and a large net, which covered the balloon during the night. Besides, the Captain had always ready at hand a certain number of ballast bags to throw out in case of danger, in order that the balloon might ascend rapidly.

Before setting out from Maubeuge, Captain Coutelle made a personal inspection to see that every possible precaution had been taken. A gust of wind dashed the balloon against a steeple, and the *Entreprenant* would have been burst had Coutelle not thrown over a bag of ballast, the effect of which was instantaneous.

The next movement of the army was towards Charleroi, and by ingenious manœuvring the balloonists managed to quit Maubeuge without attracting the attention of the enemy. They were compelled to leave the road and march with their cumbrous charge right across country, and it was at least forty miles from Maubeuge to Charleroi. It must have been a wonderful spectacle for the superstitious peasantry to see this huge globe moving unsupported through the air, conducted, or rather followed, by twenty individuals, more like demons than men; for they were nearly naked on account of the great heat, and almost as black as sweeps from the coal dust with which this mining country is covered.

As no inns were to be met with in the midst of the fields through which the balloonists passed, they had to content themselves with the few morsels of bread which the kind-hearted Flemings were able to give them. Not only friends but enemies felt impelled to come to the help of men intrusted with a mission of so extraordinary a nature, and which the prejudices of the time surrounded with so many imaginary dangers. Very often these aeronauts found ready at their halting-places refreshments and fruits, which the inhabitants had prepared in advance, in order that they might have an opportunity of questioning the men, and examining the balloon close at hand. Sometimes even their comrades belonging to other corps denied themselves a portion of the victuals which they had difficulty in procuring, in order that the balloonists might have enough to eat.

Near the end of this remarkable journey, a characteristic scene occurred to arouse the patriotic ardour of the aeronauts. The sun was just about to set, when the soldiers, who were laboriously dragging the

Entreprenant, heard all at once a dreadful noise of brass instruments. A cloud of dust rose almost to the height of the balloon. This was caused by the general-in-chief, who, followed by the whole of his staff, came to honour the balloon with a visit. At sight of the balloon a universal "hurrah" rose in the ranks from both soldiers and officers. Headed by music, the whole of the *cortége* set out at a gallop, and thus they conducted the *Entreprenant* to an abandoned and half-burned farm which had been assigned as a depot for the precious apparatus.

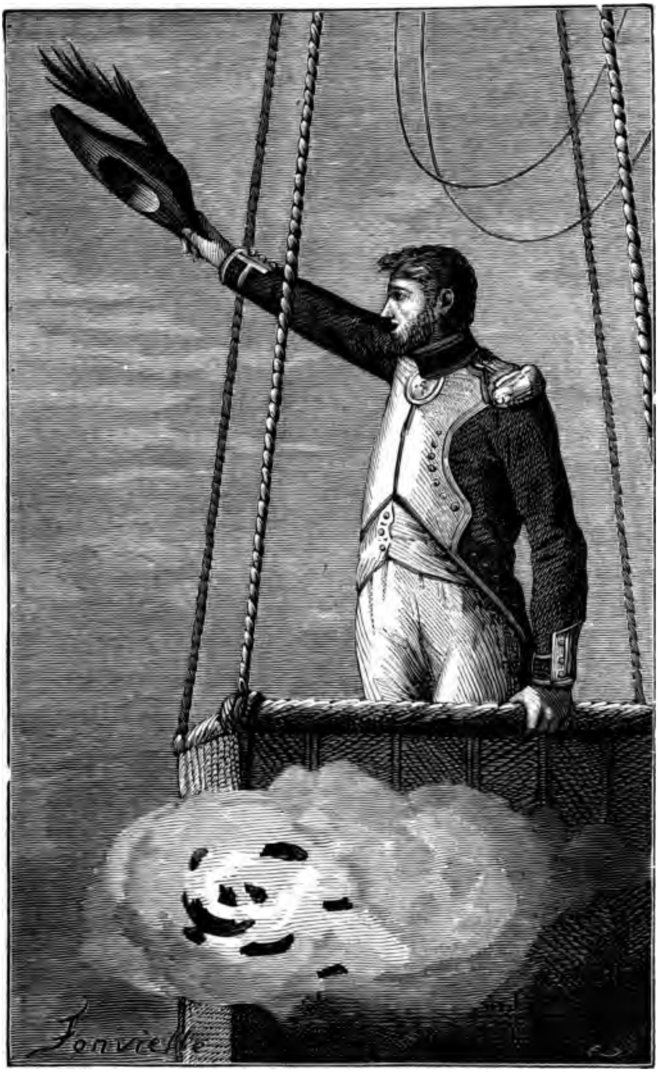
A most successful ascent was made next morning amid the deafening noise of artillery, and the same evening Charleroi capitulated.

The next occasion on which the *Entreprenant* was brought to the assistance of the French revolutionary army, was at the battle of Fleurus, in Belgium, which took place on June 26th, 1794. The observations by means of the captive balloon were executed by Captain Coutelle and General Morlot. Questions were sent up by means of a cord worked by Coutelle, and the answers were sent down attached to small bags of ballast, surmounted by diminutive banners. The numerous prisoners who were led to headquarters had to pass by the foot of the cords, and most of them attributed the misfortune of their arms to the intervention of the machine, the construction of which they could not understand, and which appeared to them a sort of supernatural fabrication. The French at this time had so bad a reputation that they might well be suspected of having dealings with an evil spirit.

The *Entreprenant* remained aloft for ten consecutive hours, and during this time the enemy could not make a movement which was not immediately signalled. Beauchamp tells a singular story, which shows what an effect was produced by the sight of the balloon. A demi-brigade made a strategic movement with which the soldiers were dissatisfied; there were murmurs in the ranks at being obliged to abandon the field of battle, when a man, pointing to the balloon, which was always hovering in the air, cried, "Would the balloon be with us if we were really on the point of abandoning the battle-field?" These few words, passed from mouth to mouth, were sufficient to restore to the men the courage and the confidence which they were in danger of losing.

Two days after the French entered Brussels in triumph, the gates of which the victory of Fleurus had opened to them. Naturally the balloon figured in the fête as the brightest ornament of the procession. But a strong wind having risen put a speedy end to its glory; it struck against a stake and was ripped up. However, it was not past mending, and ere much of the gas had escaped the rent was sewed up, and the balloon once more capable of being used.

The *Entreprenant* was made to do good service on various other occasions during the campaign, and during the winter was laid up at Liége. The success of this campaign was considered so decisive that the Government gave orders to organise at Meudon a second company of aeronauts.



CAPTAIN COUTELLE SALUTING A PROJECTILE.

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The services of the company of balloonists were again brought into requisition in the campaign of 1795. At the siege of Mainz, by the French army, the effect produced by the presence of the balloon was so great that the Austrian officers asked for an armistice, the real purpose of which was, perhaps, only to have a nearer view of the operations which aroused their curiosity so strongly. On this occasion Captain Coutelle and one of his officers remained more than an hour in the car, making observations and sending messages to head-quarters. During this time the soldiers very gallantly did the honours of the spectacle to their enemies, and greatly enjoyed the wonder with which they were overwhelmed.

But stormy weather came on, and the *Entreprenant* was subjected to, and withstood, an amount of buffeting which would shatter a modern balloon to shreds. Two men held on by each of the cords attached to its circumference, and as these cords had been increased to thirty-two, a company of sixty-four men was thus employed in holding a globe whose diameter was not more than 36 feet. Yet, in spite of their efforts and their weight, these sixty-four soldiers were raised off their feet, so great was the pressure, while the balloon itself received no damage. Seeing the danger which Coutelle ran, the Austrians of Mainz sent an officer with a flag of truce, begging the brave aeronaut, who was in the car, no longer to expose himself to the danger of death. They offered to permit him to visit the fortress if he would cease to explore by means of balloons; but Coutelle, as chivalrous as his enemies, refused, and thanked them for their politeness by offering to show them new experiments.

Shortly after, Lieutenant Lhommond took the command of a company which crossed the Rhine, and was to be accompanied by the *Entreprenant*. To avoid crossing the fortifications of Mannheim, through which the company had to pass, the balloon was left outside, surrounded by a fence of ropes and canvas, guarded by a sentinel. The balloonists were assembled in the Captain's tent, when a violent explosion was heard. Some one—who, it was never discovered, notwithstanding the most active inquiry—had riddled the balloon with a hail of bullets. It was rendered useless, and had to be emptied of its gas as soon as it was daylight.

CHAPTER XV.

FURTHER MILITARY BALLOONING.

THE French War Committee were so satisfied with the balloon operations, to which we have referred in the previous chapter, that they determined to continue them on a still grander scale in 1796. For this purpose great attention was given to the training of balloonists at the Aerostatic School at Meudon. Conté, the comrade of Coutelle, had been left behind at Meudon, but had shared in his comrade's promotion, was raised to the rank of major, and intrusted with the command of the permanent establishment.

At Meudon the pupils were not merely taught the art of manœuvering balloons, but had to study physics, chemistry, preparation of plans, geography, all subjects with which an efficient aeronaut ought to be acquainted. But Meudon was not only the centre of theoretical studies; it was above everything a place for practical observations, for the school possessed a captive balloon for the training of the embryo balloonists. These educational experiments were made at two heights. Beginners were sent up to only a height of 500 feet, and it was only after they had given proof of capacity that they were allowed to ascend as high as 770 feet.

The varnish devised by Conté was so excellent that the balloon, although constructed like the *Entreprenant* of a simple silk material, remained inflated for six months. Coutelle, although having to make ascents reputed excessively dangerous under the fire of the enemy, did not receive a single scratch during all the time he was on service, while the discovery of this valuable varnish cost its inventor an eye, although he had never been outside his laboratory. A jet of gas, stupidly lit by an assistant while Conté was investigating the action of hydrogen, burst a bottle to pieces, one of which so badly wounded Conté's eye that it had to be extracted. The Executive Directory rightly regarded this wound as if it had been received in battle, and raised Conté to the rank of brigadier of infantry, commanding the aerostatic establishments.

There were prepared at Meudon five balloons, made of a silk material manufactured expressly at Lyons. The first of these was the *Entreprenant*, whose adventures we have narrated; the second was the *Céleste*, which was sent to keep the former company; the *Hercule* and the *Intrépide* were sent, the former to the army of the Rhine, and the latter to that of the Danube, for the campaign of 1796. A fifth balloon was prepared for the army in Italy, but for some reason or other was never sent out. Perhaps the marvellous rapidity of the victories of Napoleon Bonaparte, who commanded in Italy, rendered its services useless.

The French Republic had two armies on the Rhine, that of Jourdain concentrated at Düsseldorf, and that of Moreau spread over Alsace. These two were to unite at Ratisbon and form a junction with the army of Italy, which had been ordered to march through the valley of the Adige. The army of Moreau had received the *Hercule* balloon, and the *Intrépide* had been sent to the army of Jourdain. Jourdain, who had planned a campaign which necessitated rapid marches, thought he would not be able to drag a balloon along with him. He left it in the town of Würzburg, to which the Austrians soon laid siege. The garrison made some attempt to utilise the balloon for military purposes, though one of the officers, at least, made it serve a much more tender purpose. As Würzburg was an open town, the garrison had to retreat within the citadel, and as in doing so they left some of their ballooning apparatus behind them, the machine could not be put to any military uses. They were at last obliged to surrender, and the balloonists were taken prisoners along with the rest of the army.

The army of Moreau was at Stuttgart when the *Hercule* joined it. The balloonists remained there only four days, but found ample time, like their colleagues at Würzburg, to ingratiate themselves with the ladies, to whom a trip in a balloon seems to have been a powerful attraction. Lieutenant Beauchamp, having taken a young woman up with him in the car, returned to earth completely smitten, and so far advanced in matrimonial negotiations that he wrote at once to France asking for permission to marry; but three days after, the balloon left for Dunavert, the head-quarters, and

Beauchamp left his love, and seems to have thought no more of her.

But the balloon attached to Moreau's army was not an object of delight alone to young ladies anxious to marry; grave and reverend personages held it an honour to be allowed to risk themselves in it. One day Moreau asked Captain Lhommond to take with him in his car the prior of the monastery where the former lodged. The worthy ecclesiastic had asked this favour in return for the attentions he had paid the General during his stay at the monastery. Of course Lhommond complied, and the prior settled himself in the car. According to the rule of the Meudon school, ballast was always taken in the car in order that the ascent might be carefully regulated. This ballast was contained in bags which were emptied one after the other, especially when the wind was strong; for the ascending force diminishes in proportion as the length of rope suspended in the air increases.

Seeing the size of the good monk, the Captain declared that he had no need of ballast, for fat, overfed, and apoplectic persons soon find they have enough of the balloon. In fact, scarcely 350 feet of rope had been unrolled when the assistants saw Lhommond give the signal for descent. The prior had been seized with vertigo, as happens to every aeronaut who has ate heartily in order to raise his courage. He returned to the earth much paler than when he started. After he had thanked the balloonists, at the same time promising that he would not trouble them again, an order arrived to make an ascent in earnest. As the balloon, which had been inflated for two months, had lost some of its ascending force, and there was reason to fear it might not rise to the full height, the Captain asked Lieutenant Beauchamp, who was younger and lighter, to make the ascent for him. "A report is wanted at once," he said, "so make haste." Beauchamp jumped into the car and asked for the ballast to be put in. "What do you want with ballast?" asked the Captain, "the balloon won't rise at all; we had great difficulty in getting up the length of 350 feet." "True," replied Beauchamp, "but there were two of you, and the prior weighed at least two hundredweight." "Well, well," said the Captain, "are you afraid?" To these words Beauchamp replied by signalling to let go; he mounted like an arrow shot by a powerful archer. In fact, the balloon, which had a great ascending power, rapidly acquired an enormous speed, aggravated by a squall of wind, and the weight of the cords had no effect upon it. Beauchamp saw his danger from the very first.

The noise made by a captive balloon when strongly compressed by the wind always makes a terrible impression upon the aeronaut, for it seems as if every instant the material would be torn in pieces. As we have already stated, the soldiers were never allowed to ascend in the car; this honour was reserved exclusively for the officers. Beauchamp had just been raised to his rank of lieutenant, and was not familiar with all the intricate details of management. It seemed to him as if the ropes had broken and the balloon was already torn. During this time the balloon kept constantly rising. It was only when it reached a height of 1200 feet that the soldiers were able to moderate its speed.

Once the balloon came to a stand-still, Beauchamp cast his eyes around him. A magnificent spectacle lay before him. He was amply repaid for his apprehensions, for the dangers which assailed him existed only in his imagination. At his feet a magnificent river rolled on its way to the Black Sea, and he could discern the distant mountains where the Danube took its rise. The Austrian army was in full retreat; yet it was warmly disputing every inch of ground with the French, the last columns of whom had scarcely crossed the river. Not a movement of the enemy escaped him; but the French head-quarters were not at the foot of the rope, as at Fleurus, and time would be lost in sending messages to Moreau. However, Beauchamp threw down small bags bearing a tiny flag, and the courier rode at lightning speed to the General, all of whose movements he was able to follow. The descent was not without danger, for as the wind had not fallen, all the difficulties of the ascent had again to be encountered. Beauchamp lived till the year 1850 to record the terrors of this ascent, which must have made a deep impression on his mind, to judge from the vivid manner in which he described it so long after.

The company of aeronauts, with Conté, Coutelle, and Lhommond, accompanied Napoleon in his famous Egyptian campaing in 1798-99, but their peculiar services do not seem to have been brought into requisition. Attempts were made to astonish and impress the Egyptian Arabs by various aeronautical exhibitions, but these imperturbable individuals looked on unmoved. A formidable array of scientific establishments had been attached to the French army in Egypt, and several of the balloon officers, who were accomplished in science, were attached to these, and some of them made journeys of exploration which are even yet considered valuable. On the return of the balloonists to France, they found the aeronautical service completely disorganised; the men were ordered to return to the regiments of the line, while the officers were attached to the corps of Engineers, Conté and Coutelle with the rank of Colonel, Lhommond that of Major, and Planazet Captain. All their apparatus were sold by auction, and were bought by the scientific aeronaut, M. Stephen G. Robertson. Only one balloon was kept, and this we shall find by-and-by was inflated by Conté and used in the ascent by Biot and Gay-Lussac. As for the old Château of Meudon, it was in the end demolished, and its marble columns carried to Paris, where they now form part of the Arc de Triomphe.

CHAPTER XVI.

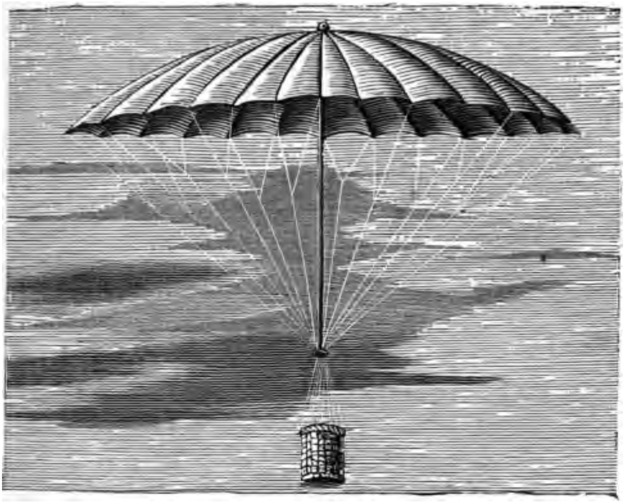
GARNERIN AND PARACHUTES.

During the first French Revolution, ascents were frequently made to celebrate great national events. Indeed, the new Constitution of the French Republic was magniloquently proclaimed to the sun and the clouds from a balloon at the height of 12,000 feet.

André Jacques Garnerin (born 1769), the most celebrated of the aeronauts of this period, was a pupil of the physical class of M. Charles. He was only about nineteen years old when he first tried his fortune in the air. His first experiment was made at Metz in 1787. He made a fortunate ascent with a lady of Turmerman, and descended at a distance of nine miles. In 1790 he set out with a simple montgolfiere from the gardens of Ruggieri. It appears that he had attempted captive ascents at the Luxembourg with an air balloon, and that it was partly the success of his experiments which led to the organisation of the corps of military balloonists, of whose fortunes we have given some account. But the accomplished aeronaut was sent on a political mission which prevented him from having any share in the work of that corps.

Garnerin's elder brother had rendered Government some service, and was rewarded by receiving the appointment of Commissary to the French Armies. Young Garnerin was soon sent on a similar mission. The division of the army that young Garnerin had been sent to inspect was in a most precarious position, and shortly after his arrival was defeated (1793), and Garnerin fell into the power of the English. The latter handed him over to the Austrians, by whom he was imprisoned in the fortress of Buda, in Hungary, where he was kept for about two years.

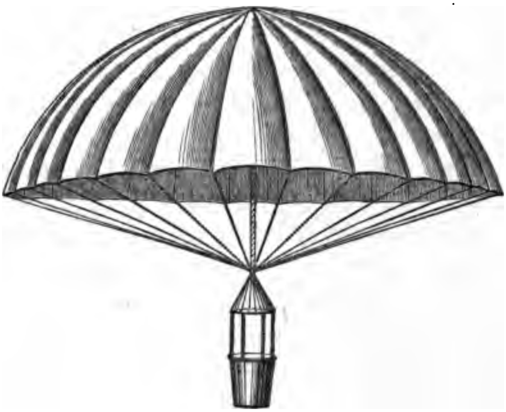
On his return to France he betook himself again to aeronautics, and associated his brother with himself in making great public experiments. In order to secure public interest, he made night ascents in which he carried a lamp to light up his balloon. Garnerin states in his memoirs that while in prison he thought of making use of the parachute for the purpose of escaping. Garnerin and his elder brother subsequently disputed bitterly the honour of inventing this apparatus, which, as we have seen, was years before made use of by Blanchard. Garnerin, however, was the first human being, so far as authentic accounts go, who made the first descent in a parachute. The first public experiment was to have been made on June 15th, 1797, in the garden of the Byron Hotel, now the Convent of the Sacred Heart. The balloon in which Garnerin was to ascend was ready, and he was about to step into the car, when a squall of wind tore the balloon into shreds. The spectators were indignant, and the balloonists had to take to flight to escape the public fury. One of the spectators accused the two brothers of swindling, and of extorting his money from him under false pretences, and it was with some difficulty they obtained their liberty on bail. Three days later young Garnerin did make a descent in his parachute in the Gardens of Tivoli.



BLANCHARD'S PARACHUTE.

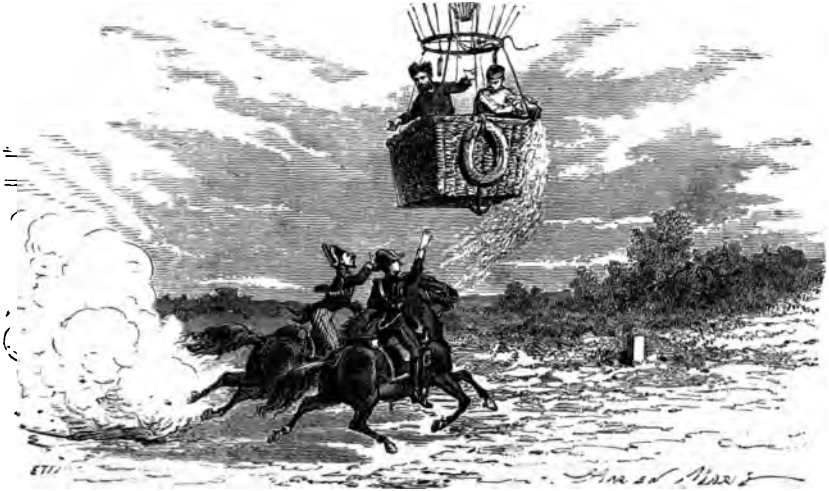
Garnerin made his experiment in the parachute in a most theatrical manner, and under conditions well calculated to produce a profound sensation. He had devised a mechanism by which the balloon was torn open while the rope was cut. Supported by his parachute, which seems to have been attached to the balloon in place of the car, the daring aeronaut reached the ground in safety after the remains of the balloon had fallen.

In the first experiment the parachute oscillated in a most violent manner, and to prevent himself from being pitched out of the car he had to hold on with all his strength. Jérôme de Lalande, the famous astronomer, and who at first was violently opposed to ballooning as a theoretical impossibility, perceived that the cause of these oscillations was that the air compressed by the descent of the parachute could not escape in a regular manner. He advised, therefore, that a hole should be made in the centre of the parachute, in order that the air might thus run out of it with regularity. This was afterwards done, and hence the apparatus, notwithstanding its immense size, resembling a gigantic umbrella, became perfectly manageable.


GARNERIN'S PARACHUTE.

After these preliminary experiments with the parachute, Garnerin wished to make balloon ascents in company with a lady, Mademoiselle Célestine

Henry, but in this he met with unexpected opposition from the police. The latter were supported by some of the medical faculty, who maintained that the effect of an ascent would be disastrous to the delicate constitution of a young lady. It took two months' incessant application and explanation ere Mademoiselle Henry received permission to accompany Garnerin, and then only after she had been minutely questioned and given a solemn assurance that no secret influence had been used, but that she desired to ascend of her own free will. In this difficulty, Garnerin received unexpected and generous support from Lalande, who, when at last the young lady was permitted to make the ascent, gallantly led her to the car on his arm. Garnerin made two ascents with his brave companion. The first ended near a village named Dugny, where Garnerin met with quite an unforeseen difficulty. A municipal official demanded a passport from the travellers, and as they could not comply with the demand they were arrested. It required the indignation and threats of the people who had been attracted by the descent of the balloon to compel this too zealous official to release his two captives. The journals of the time could not fail to comment on this ludicrous incident. The official, whose name was Hennequin, was mercilessly chaffed. He wrote a letter in justification of his conduct, in which he tried to pass the affair off jocularly. "You forget, Mr. Editor," he said in effect, "that the duties of my position require me to arrest vagabonds, and that nothing more resembles a vagabond than a person falling



" YOUR PASSPORTS."

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from the clouds." From that time Garnerin took the precaution of carrying a passport; but in his second descent he fell into the hands of a person who could not read, and consequently his passport was a dead-letter.

In the course of 1798 Garnerin made many ascents of long duration, sometimes alone, sometimes with a companion. On each occasion he was careful to note the speed of his balloon and the direction which it followed, for the purpose of proving that he could carry instructions to armies much more rapidly than any system of telegraphing then in use. These aerial journeys of Garnerin were not without value from a scientific point of view, for he carried vessels filled with water, which he emptied and then shut up at a very great height for the purpose of taking down with him samples of air of the higher regions. The first analyses were made by Humboldt, who found that the proportion of oxygen had diminished by two per cent.

During this time Blanchard, who had returned from America, endeavoured to draw attention to himself. He announced his intention of crossing the Atlantic by means of one of his famous aerial flotillas. He had constructed for this purpose a car which he maintained would not sink, and which he got tremendously advertised and puffed. We need scarcely say that this vast chimerical project was never executed. At the same time the old aeronaut claimed the invention of the parachute. Garnerin sharply defended his right to the invention. Blanchard at last resolved to gain the laughers to his side by imitating his rival, and showing that his parachute was as serviceable as that of Garnerin's for descending from the clouds; for Garnerin maintained that his parachute was really a new invention, Blanchard's being only of use in the case of cats and dogs.

It was in July 1799 that this experiment was made from the Gardens of Tivoli, on the ground now covered by the Western Railway Station. There were light and not very steady winds. Blanchard took advantage of them to cross the Seine twice and perform numerous circuits in sight of the public, who from all parts of Paris kept their eyes fixed on the balloon. When he found himself above the Bois de Boulogne he cut the cord by which his parachute was held, and came down gently, without accident, in one of the splendid gardens which then adorned that part of the environs of Paris. This success, of course, could not prove the validity of his claims, but it brought him an honour which he little expected. Lalande, the astronomer, at last accepted the proposal made twelve years previously, and consented to accompany Blanchard in a balloon.

Blanchard, having given up all idea of mechanical direction, discovered a much more simple process for guiding his aerial flotilla. It was sufficient to lower a sort of sail acting somewhat like a movable anchor for fixing to some extent the route of the aerial navigator, and prevent him quitting a favourable current when once he found it. Nothing could be more artless than the reasoning employed by the Director of the Paris Observatory, for such was

Lalande at this time, to prove that he could find a wind that would guide him in any direction he chose. "It is very probable," he wrote in an official article published in the *Moniteur*, "that the upper atmosphere is occupied by a current from the west; consequently we may presume that before reaching this height Blanchard will reach an oblique wind coming from about W.S.W." This was the wind which the Director of the Paris Observatory wished to follow, for he intended to pay a visit to his colleague at Gotha.

What was not less strange than the confidence of the French astronomer, was the extraordinary sensation which the announcement of the experiment produced in Germany. As little able as their French colleagues to perceive the absurdity of a most grotesque proposal, the German *savants* came from all parts to the Observatory at which the adventurous Lalande was to arrive. The police officials of the German principality bestirred themselves. They felt uneasy at the revolutionary propaganda which the astronomer of the French Republic, descending from heaven like a new prophet, would be sure to make. But all their preparations were found useless, for this ascent, so pompously announced, did not last many minutes. The balloon on which all the *savants* of Germany were ready to fix their telescopes, rose at Tivoli and came down at the Bois de Boulogne. Immediately the rumour spread that Blanchard had been corrupted by the foreigner. Had it occurred in the time of Robespierre, who held aeronauts in horror like every good terrorist, Blanchard would have had a fine chance of being guillotined.

It was on October 21st, 1798, at this epoch of aeronautical revival, that Testu Brissy made his first equestrian ascent at Bellevue. He had not succeeded in his first attempt on January 7th preceding. The experiment was not made in the same manner as in our own time, when horses have been unceremoniously attached underneath the car by means of girths. Testu Brissy took the trouble of placing his horse on a platform of wood, and mounted on his back armed *cap-a-pie* like a chevalier of the middle ages. The ascent was rather unpleasant, as the horse became a somewhat embarrassing object to pull down, but the aeronaut did not experience any accident.

Testu Brissy, in his first ascent, established a very interesting physiological fact. The blood of the horse begins to flow from the nostrils and ears at a height at which man suffers no inconvenience. This circumstance gave rise to a singular incident, when, half a century later, it was attempted to introduce into England equestrian ascents, revived and modified in France by M. and Mme. Poitévin. Green, of whom we shall hear much further on, wishing to sustain his old reputation for novelty, announced that he would make an equestrian ascent from Cremorne Gardens. But the Society for the Prevention of Cruelty to Animals interfered, on the ground that horses could not, like men, sustain the depression, and that it would be cruelty to subject them to an exercise which is an invariable cause of bleeding. Not wishing to contest the matter, Green sought for a horse that would not bleed; he made his ascent on a wooden horse. The representation, thus somewhat burlesqued, was an immense success. But we need not say that Green did not repeat it.

As soon as the Peace of Amiens was concluded (March 1802), Garnerin received pressing invitations from the French ambassadors at various foreign courts, where he was enthusiastically received. His welcome was sometimes so cordial as to give rise to a rumour that he was entrusted with a secret mission by the First Consul, Napoleon Bonaparte.

It was in England that Garnerin made his first ascent abroad, and the parachute became quite the rage. It was even more successful than Blanchard's famous flying ship. The London public so lionised Garnerin that the only obstacles he met with were those presented by nature and the ignorance of the country people. Sometimes, in a remote part of the country, he could find no one to help him in his descent; instead of holding the ropes, the peasants thought it advisable to save themselves by taking flight.

The partisans of France made it their duty to render Garnerin all possible assistance. Thus, at a grand ascent made from North Audley Street, London, it is stated that the great Sheridan himself cut the cord of silk that held one of Garnerin's experimental balloons.

Garnerin, after leaving England, went to Berlin, where he met with a curious series of adventures. A certain Hermbstädt, Professor of Chemistry in the

University of Halle, and a Councillor of State, jealous, it is said, of the glory of Lalande, offered 200 fredericks d'or to the French aeronaut to purchase a place in his car. Garnerin accepted the offer; but like a man who had a good eye to business resolved to take his passenger with him during a public ascent; otherwise the Professor's money would all have been absorbed in the expense of inflation. Lalande did not deem it derogatory to his dignity to ascend from the midst of a crowd, and why should the German Professor go about the matter secretly, as if he were doing an evil deed? The car was large enough to hold three persons—Garnerin, his wife, and the Professor. Garnerin, however, told the Professor that some unforeseen circumstances might occur to prevent all three ascending at one time, but that he himself and his wife would ascend first, and the Professor could follow the direction of the balloon on horseback, and would be taken in after a short distance was run. After having satisfied the assembled public, Garnerin would descend in the neighbourhood of Berlin, and depositing his wife, would take the Professor on board the car, and carry him up to or beyond the clouds with all his scientific instruments.

Hermbstädt, who had had time to reflect, seems soon enough to have rued his bargain, and was on the outlook for a pretext to break it. He made this proposal of Garnerin's an excuse for demanding back his money. "I shall take you up so high," said Garnerin, in order to calm him, "that you shall see the sun long after it has set for the *savants* who remain on the earth. I shall lead you to the celestial plains where Blanchard was on the point of perishing, and where the air is so rare that the human lungs cannot breath it. On the faith of an aeronaut, I shall not descend until you yourself give the word."

But none of these brilliant promises could seduce the brave Prussian Professor, who persisted in his demands. Garnerin then announced that he would make the ascent, and that the place in the car would be at the disposal of the Professor; but that, if the latter was not present at the time of departure, he would take with him gratis an inhabitant of Berlin. So said, so done. Garnerin set out in presence of the King and Queen of Prussia, having with him his wife and a well-known Berlin merchant.

The ascent was successful. Garnerin, his wife, and their companion remained several hours in the air. On his return to Berlin, Garnerin declared that according to his barometer he had reached a height of 6300 feet. The height was nothing extraordinary, but it seems to have been too great for the friends of Professor Hermbstädt. Dr. Gilbert, editor of the 'Annalen der Physik' wrote to prove that Garnerin could not have exceeded 4200 feet: a height too inconsiderable to satisfy so eminent a *savant* as Dr. Hermbstädt. He did not require to mount in a balloon to reach a height even greater than that. Was he not in the habit of watching the famous Spectre of the Brocken on the top of the Harz Mountains? Hermbstädt had indeed rendered great service to science by refusing to risk his valuable life. Thus wrote Dr. Gilbert, who however, it should be remembered, was a really able and eminent scientific man. In spite of Gilbert's objections, the Court of Prussia loaded Garnerin with honours and presents.

From Berlin Garnerin proceeded to Russia, where he was received by the Emperor with as much distinction as if he had been the most popular opera singer of the day. He made many ascents with his wife, which were at least great financial successes. Before returning to France, Garnerin of course took all possible advantage of so rich a field; but his later ascents in Moscow were not without danger. He returned to France with great store of roubles and with the self-imposed title of the Great Aeronaut of the North.

CHAPTER XVII.

THE SCIENTIFIC AERONAUT, ROBERTSON.

It was this celebrated aeronaut who originated the scientific ascents of the beginning of the present century, and considerably widened the sphere of rudimentary observations made by Garnerin. He was a better observer than the Academicians with whom he will be found in competition. Some details concerning his career may be interesting.

His real name was Robert. He was born in 1763 at Liége, of wealthy parents, who sent him to Paris to be educated. He took the course of physics with Charles in his celebrated laboratory, from which had issued Garnerin, Conté, Coutelle, and balloons. Robertson deemed it prudent to quit Paris in 1793 and did not return till after the fall of Robespierre had given some sense of security to men of literature, science, and art. He then determined to set up an establishment of scientific amusements, in which he performed wonders analogous to those which made the reputation of the celebrated conjurer Cagliostro. But instead of using his apparatus to make his dupes believe that he possessed supernatural powers, Robertson employed his skill to expose the tricks of charlatans. The marvellous discoveries of Volta and Galvani soon added a new element to his representations.

When Robertson required more room, he removed his apparatus to the ruins of the Capucin Convent, near the Place Vendôme, then situated beyond the boundary of Paris. After having passed through the cloister of the old minster, adorned with fantastic paintings, the visitor entered Robertson's cabinet, where a multitude of curious instruments were displayed with the greatest art. The visitor then found himself before a door of antique shape, covered with hieroglyphics and which seemed to be the entrance to a sanctuary. This door opened into a gloomy place, feebly lighted by a sepulchral lamp, and with some ingenious figures placed around. A profound calm; absolute silence; a sudden isolation in marked contrast to the noisy street left behind; all seemed significant of another world. The room was hung with black velvet adorned with death's-heads; the walls and the floor itself was covered with carpet so thick that every sound seemed muffled.

Robertson suddenly appeared underneath the sepulchral lamp, and recited a short harangue on the dangers of superstition. Scarcely had he uttered the last word when the flickering light went out, and the spectators were plunged in absolute darkness. To the noise of rain, of thunder, of the funeral bell calling forth the shades, succeed piercing sounds. The ceiling is streaked with lightning in all directions. In the distance a luminous point, almost imperceptible, rises. A figure gradually assumes shape and slowly approaches. At each step it increases in size. It advances until the spectator mechanically puts out his hand to defend himself from the enormous shadow which seems on the point of touching him. At that moment it disappeared quick as thought. All these surprising effects were easy to produce by means of the phantasmagoria which Robertson professed, not quite accurately, to have invented, but to which he had certainly added many important improvements.

Robertson's first balloon ascent was made, according to the statement in his memoirs, before the same Turkish Ambassador who had so philosophically beheld the wreck of Garnerin, but who this time saw the bold adventurer start on several hours' trip in the midst of space.

Robertson, who lost no opportunity of advertising himself, resolved to buy at a public auction the famous balloon of Fleurus. He did not, however, resign his profession of physicist, any more than Coxwell, the well-known English balloonist, has renounced that of dentist. That union of two professions more congruent than those of the English aeronaut, was calculated to produce excellent results. Robertson rapidly made a fortune; he was a millionaire when he died in 1837.

France, when Robertson appeared upon the scene, had got pretty well tired of balloon ascents. Robertson, therefore, went to Hamburg, where he arrived in time to make an ascent on the summer solstice, June 22nd, 1803. Unfortunately, a violent wind quickly rose and blew with such a frightful impetuosity that the Fleurus balloon was snatched out of the hands of the workmen who were inflating it. It was found 90 miles distant from Hamburg—a distance which it seems to have traversed in the space of an hour. Robertson, who was inspired with the genuine aeronautic fire, was not discouraged; he recommenced his experiments, with the assistance of an energetic Frenchman named Lhöest, who had fixed himself at Hamburg as a teacher of music.

As the scientific aeronaut made no secret of his systematic hostility to Garnerin, he immediately gained the friendship of all the enemies that the inventor had made along his route. Dr. Hermbstädt, of the University of Hallé, and Dr. Pfaff, of the University of Kiel, declared themselves his ardent admirers. Both pretended to be dying to accompany Robertson in his aerial journeys, but the former was prevented by the duties of his office: the King of Prussia, whose servant he was, had commissioned him to inspect the mines of Freyburg. As for Pfaff, he could not resist the tears of his wife, who threatened to sue for a divorce if he persisted in his mad folly of ascending into the air.

Robertson's ascents, let us repeat, are the first which deserve to be considered as having had for their aim the investigation of the physical phenomena which take place in the midst of the aerial ocean. Robertson's observations were certainly made in a most irregular and haphazard fashion. He carried out but a very small portion, indeed, of the magnificent programme which Lavoisier had drawn up in the name of the French Academy. Besides the fundamental idea of investigating the force of the terrestrial magnet, which had been indicated by Lavoisier, Robertson made various physiological experiments. Before his time no one had thought of taking up birds and subjecting them to the effects of depression. He had the honour of taking in his car the first carrier pigeons which were raised by the mechanical power of gas to a height to which the eagle had never soared. The observations which he made upon their flight have been confirmed by all the aeronauts who have made high ascents. The effects which he observed upon himself are identical with those which have been often observed since, and of which the catastrophe of the *Zenith* furnishes a recent and terrible example. Robertson's account does not contain any improbability nor any exaggeration. Difficulty of breathing caused by the great rarity of the air; great dryness of the throat produced by evaporation of the secretions; swelling of the veins; tendency to bleeding and to sleepiness,—all these symptoms Robertson has described with great cleverness and with the sobriety of a man who has returned to the earth with his head full of truths.

He even perceived—what has not always been the case, with so little intelligence are aerial expeditions often conducted—the necessity of struggling against the torpor which threatened to deprive him of the use of his senses. He advised aeronauts who wished to go as high as he did to take with them volatile alkali or excessively strong vinegar. He devised an ingenious mechanical means of overcoming sleep.

Attached by a cord to his companion, he shook the latter whenever his eyes showed symptoms of closing, and Lhoëst performed the same service to Robertson whenever it was necessary. Robertson has been dubbed a charlatan by those who have imitated the instruments that he devised, and even by those who neglected his directions and precautions.

Robertson also devised a method of collecting the manifestations of the electricity which exists in the air, and which is somewhat difficult, as a balloon is a completely isolated body. According to the principles of physics, no sign of inductive action can be observed unless the electrical instrument in the car be withdrawn from the influence of the surrounding medium. Robertson succeeded in solving, in a very simple fashion, this problem which had puzzled more than one French Academician. Since his expedition, no one has attempted a better solution. He simply attached an electrometer (an instrument for measuring the intensity of the electric spark) to an insulated wire which plunged into the lower air at a considerable distance from the balloon, and which thus collected the inferior electricity.

Robertson made, besides, a very important discovery, the bearing of which he himself did not comprehend. He decided to take with him a galvanic battery. He saw to his great surprise that the spark was much more elongated than on the earth. He thus perceived that the electric current circulates better in rarified than in ordinary air. The principle of the construction of an important scientific apparatus, the Geissler Tubes, was thus discovered twenty years before they were devised by the man whose name they bear.

Most of these results appear to have been obtained during an ascent made by Robertson and Lhoëst from Hamburg on July 18th, 1803. The balloon remained five and a half hours in the air, and came down near Hanover, 75 miles off. It rose to a height of 23,526 feet, and the thermometer fell to nearly 19°, or 13° degrees below the freezing-point. Besides the experiments above referred to, they made others on sound, on the boiling-point, the colour of the sky, and other points. When a few grains of chlorate of potash were exploded, only a slight crack was heard instead of a loud explosion, as would have been the case on the ground. It was found quite possible to hold the hand in boiling water, showing that water boiled at the above height at a much lower temperature than it would do below. Robertson took up a thermometer with him to measure the temperature of the water, but instead of plunging it into the latter, he thrust it into the fire, and so broke it. This, as Mr. Glaisher suggests, reminds one of Newton, who put his watch into the hot water and held the egg in his hand. Of two birds which Robertson took up with him, one died, and the other, when put on the edge of the car, flapped its wings without moving from its place, but after a short time fell down as if it had been a stone. The colour of the sky was observed to be dark grey. These results are mentioned in detail because this was the first really scientific ascent, and subsequent experiments have only served to confirm the accuracy of Robertson's observations.

Another ascent was made on August 14th, 1803, and the Hamburg ascents were succeeded in the following year by an ascent at St. Petersburg, under the auspices of the Academy of Sciences there. This ascent took place on June 30th, 1804, and Robertson took with him all the instruments he had used in his previous ascents. This time, however, he was accompanied by a distinguished chemist and physician, a member of the St. Petersburg Academy, M. Sakharoff. This ascent is remarkable for a daring but intelligent application of the principle which Pilâtre had discovered of the variation in direction of different currents of air. The upper wind was blowing towards the Baltic; Robertson's balloon, therefore, made for the shores of that sea, and the two aeronauts found themselves in danger of death. But Robertson saw, about 3000 feet below the car, light clouds sailing along towards the land; by working the valve and the ballast he succeeded in reaching this landward current, and thus came down upon the solid earth. The height reached on this occasion was only 8,868 feet.

Robertson made several other ascents in Russia. He relates in his memoirs that on one occasion he perceived that his only companion in the car was mad, and that the unfortunate individual, in his delirium, wished to throw himself headlong to the earth. Robertson had to use violence to prevent him carrying into execution a design which might have led to the death of both aeronauts.

Perhaps the story, which has been frequently reproduced since, and told of various aeronauts, was only the invention of Robertson's imagination, for he neither gives the person's name, nor that of the place where, nor the date when, the ascent took place. But, true or false, this adventure deserves some consideration, for it shows the risk that would be run by any balloon which suddenly lost the ballast-weight of a man. If this circumstance had never been lost sight of, some of the most terrible catastrophes which have marked the history of balloons might have been avoided.

CHAPTER XVIII.

BIOT AND GAY-LUSSAC.

THE reports of Robertson were sent to the Galvanic Society of Paris, and produced a great sensation among the members. The French Institute could no longer keep aloof from experiments which its most illustrious members had enthusiastically praised; the scientific section of the Institute bethought itself of Biot, who had gained great honour by his investigation of the famous fall of stones at Laigle. To this young man of science, who had shown that these stones were nothing else than fragments of stars descending from space, and increasing the mass of the earth by their weight, ought to fall the honour of sounding the celestial infinite. They associated with this young but already celebrated physicist the young Gay-Lussac, who had just left the Polytechnic School. The former was, at the time referred to, 30 years of age, and the latter 26.

Happily, one of the balloons of the Meudon Institution had been preserved, and this was placed at the service of the delegates of the Institute, and enabled them to take part in the experiments of 1804. The inflation was intrusted to Conté, the director of the suppressed institution.

The departure of Biot and Gay-Lussac was to have taken place in the garden of the Luxembourg, near the Palace; the preparations having taken longer to complete than was expected, the ascent was postponed till the day after that originally fixed, and the balloon was attached to posts during the night. On the morrow the experimenters found their balloon gone. The posts had been fixed in the ground, which had been newly dug up, and the balloon had been carried away by a squall of wind. It would have been lost if some passer-by had not seized hold of the cords and prevented it from getting quite out of reach.

On account of this accident it was decided to make the experiment anew at the Conservatoire des Arts et Métiers, that magnificent French Art and Science Institution, which had then only been recently founded in the Rue St. Martin, where it still remains. Two ascents were made from this institution. The first, by Biot and Gay-Lussac, took place on August 24, and was described in great detail in the *Moniteur Universel.* The aeronauts did not, however, succeed in rising higher than about 13,000 feet, and it was hence decided that one of them should remain on the ground while the other should have the sole honour of making a fresh experiment. The choice fell upon Gay-Lussac.

In his second ascent, Gay-Lussac reached a height of about 23,000 feet, lower by several hundred feet than the height reached by Robertson, though the statement of this professional aeronaut has been discredited by many, and the decision been given in favour of Gay-Lussac, who, rightly or wrongly, held the place of honour till the ascent of MM. Barral and Bixio. It is right to state, however, that some writers maintain that no aeronaut has ever reached such a height. Discussions to determine the height which aeronauts have reached, are for ever cropping up in the history of ballooning, and will only cease when we have some methods of registering heights more accurate than the barometer.

Gay-Lussac set out alone on September 16th, 1804, at 9.40 A.M., and touched the earth again at 3.45 P.M., between Rouen and Dieppe, near the village of Saint-Gournay. He was thus a little over six hours in the air—a time amply sufficient to make a multitude of observations. In reading the account of his aerial journey one is astonished at the activity which he must have shown; but it is impossible to place implicit confidence in the accuracy of his observations, for a divided attention among too many objects is incompatible with great delicacy in determinations. It was a disadvantage that Gay-Lussac was alone, as much more service can be rendered to science by two in a balloon than by one. However, the observations he did make, when all deductions are made, were rightly, at the time, considered an important accession to scientific knowledge.

When he had attained a height of about 22,000 feet, Gay-Lussac committed a serious error, of which, happily, the consequences, which might have been terrible, were only amusing. Eager to mount higher and higher, for "Excelsior" is the motto of all tyro balloonists, Gay-Lussac threw overboard a white wood chair, which might have felled some one, or caused serious damage, had it fallen upon any building. The piece of furniture fell, however, into a bush, quite close to a young woman who was quietly watching her sheep; the sky was calm and the balloon was invisible. "What was to be made of the chair?" says Arago, who tells the story. "Could they help believing that it had fallen straight from Paradise? The only objection to this theory was the rudeness of its make. Up there, the disbelievers said, they do not employ such unskilful workmen. Thus stood the dispute, when the papers put an end to it by telling the true story of the phenomenon."

CHAPTER XIX.

THE LAST OF BLANCHARD.

THE ascent made by Blanchard in company with Lalande was his last triumph. On February 19th, 1800, he made his forty-sixth ascent at Nantes, the citizens of which he rebuked on account of their ungenerous conduct. Groups of close-fisted spectators perched themselves economically on the heights in the neighbourhood of the place of ascent, in order to enjoy the spectacle without payment. Blanchard was naturally irritated at such conduct, and published a thundering manifesto against the economical people of Nantes. "My object," he said, "is not to acquire glory, but to obtain the fruit of my labour. Notwithstanding my love for an aeronautical career, I declare that I shall for the future stick to the solid earth, the public having put it out of my power to make new experiments. I therefore make an end here of my ascents, and my aerial flotilla is for sale. My collection of balloons is composed of 1,800 ells of taffeta of good quality. I shall give good bargains to any amateurs desirous of purchasing. These dismembered balloons will make excellent cloaks, caps, aprons, and umbrellas."

This lament ends by a last appeal to the rich

Nantais, of whom he gives a long list, and who had taken up advantageous positions that they might enjoy the ascent gratis. "I beg to inform them," adds the chagrined aeronaut, "that they all owe me a contribution equal to the price of the back seats, which is fixed at thirty sous." Blanchard took care to give his address, which was at the house of Citizen Garos, hairdresser, Rue de la Comédie-Brûlée. We are glad to believe that this appeal *ad latrones* was listened to, for Blanchard did not sell his stock-in-trade.

We find him at Lyons making his fifty-fifth ascent, troubled by an unexpected event. He found it so cold that when he attempted to open the valve he could not manage it: the lid was soldered to its seat. Luckily, by dint of pulling at the cord, he managed to break the ice, which had compelled him to stray into lofty regions, much against his will.

Here is another curious accident. A violent wind blew at the time of Blanchard's departure on one occasion, at Lyons also. He had remained five hours in the air, and very naturally thought he must have run an immense distance. But, after being buffeted between a multitude of counter currents, the balloon came down quite close to Lyons. For five consecutive hours he had been the sport of the winds, which made him describe a regular network of zigzags.

The last ascent of this adventurous son of the air was made near the Hague, at the castle of the King of Holland, early in February 1808. Contrary to his custom, Blanchard made use, on this occasion, of a montgolfiere. Scarcely had he left the ground when he felt himself seized with an attack of apoplexy. He all at once became quite powerless. The fire, upon which he had been about to throw some straw, went out. The machine fell heavily to the ground from a height of sixty feet, and the unfortunate man lay stunned like a gymnast who has missed his trapeze. King Louis, who was present when the balloon started, hastened to give his fellow-countryman all the help which his position required. Blanchard recovered consciousness. He was able to be carried to Paris, which he reached sadly enfeebled in mind as well as body. His mental state was so eccentric that the medical journals of the time described and commented upon all the details of his peculiar affection.

Blanchard's finances were in no better condition than his health, for the pension which Louis XVI. had awarded him after he crossed the Channel had been suppressed along with all other Court pensions. The unfortunate aeronaut was in such a state of distress and destitution that some time before breathing his last, he said sadly to his wife, "My poor dear, when I am dead I fear you will have no other resource than to throw yourself into the water." But Madame Blanchard, who had both energy and intelligence, instead of following this desperate advice, prepared to take a plunge into the air, where she gained both fame and success, dearly bought, however, by a tragic and premature death.

Blanchard died March 7, 1809, without having had any real influence on the progress of aeronautics. He may be blamed for his vanity and a sort of charlatanism, for which there is little excuse; but he deserves to be remembered, not only for the daring with which he faced the perils of an aerial journey across the sea, but for a multitude of attempts, some of which were crowned with success.

While poor Blanchard experienced all these catastrophes, a favourable wind filled the sails of his rival's balloon. Garnerin was appointed to superintend the aeronautical rejoicings which accompanied the inauguration of the first French Empire under Napoleon Bonaparte. He entered upon his duties, which might become hereditary, during the fêtes connected with the coronation of his Imperial Majesty, which took place at Rome, by the Pope, December 2, 1804. But, alas for his bad luck! what might have made the fortune of the inventor of the parachute, was precisely what ruined him.

A wreath of 3,000 lamps was attached to the balloon, representing in lines of fire the crown which the Pope had just placed upon the head of the second Charlemagne. Garnerin launched into the air his masterpiece, which rose amid the joyous shouts of thousands of spectators. It was believed that the crown of Napoleon Bonaparte would float a long time in the air, for it was under the protection of his star; there was no need of an aeronaut to guide it. People were not deceived in this. The ascent was an extraordinary long one. The oil in the lamps acted in place of ballast, and as it gradually burned away, the balloon was able to maintain itself in the air with a stability which the hand of man could not have given to it. Next morning it was seen wandering over St. Peter's and the Vatican. But soon its good fortune deserted it. The oil became exhausted, and the balloon, gradually descending, struck the cornice of the tomb of the infamous Nero. It was caught on one of the angles, and only managed to free itself with the loss of part of the crown. It ended its career ignominiously in the muddy waters of Lake Bracciano.

These extraordinary circumstances gave rise to a multitude of pleasantries, which deeply wounded Napoleon, who never had any great favour for balloons. Although he was a member of the Academy of Sciences, Napoleon had only a very limited knowledge of physics. He fancied that poor Garnerin had sent off the balloon with the malicious intention that it should be a failure, and thus ended all hope of the balloonist gaining the capricious Emperor's favour.

CHAPTER XX.

THE FATE OF ZAMBECCARI AND OTHER ACCIDENTS.

THE reader will not have forgotten Count Zambeccari, of Bologna, one of the earliest experimenters with balloons, but who, unfortunately for himself, had not abandoned his profession of sailor. In 1787 he fell into the hands of the Turks, who kept him prisoner for three years in the bagnio at Constantinople. He, like Garnerin at Buda, dreamed—seductive dream for a captive!—of the means of guiding himself through the clouds, with which he had already made acquaintance, but which he could now only see through the bars of his prison.

He had been struck with the power of the combination of means by which Pilâtre proposed to select the aerial currents. He could not, in fact, imagine a more simple and convenient process, for a pound or two of oil burned in a lamp under an inverted parachute would make a balloon ascend ten times higher and ten times faster than would the same quantity of sand thrown overboard. Only the fear of perishing by fire might arrest experimenters with such a combination, but such a fear did not exist for so daring a man as Zambeccari. He, moreover, complicated his apparatus with a sort of rudder, which overloaded it with a useless weight, and multiplied the chances of accident.

Scarcely was he set at liberty, when he made for London, the theatre of his first aerial exploits. Not being able to find in England the funds which he required, Zambeccari returned to his native country, Italy. At Bologna he managed to raise the necessary funds, and arranged an ascent in company with Dr. Grassetti and M. Pascal Andreoli. The ascent took place at night in a fire balloon. They took with them instruments and a lantern, by which to see and to make observations. The intention was to take advantage of the wind, which blew strongly towards the north-east, towards Milan, the direction in which the aeronauts wished to go; but the departure was badly regulated. The aeronauts passed beyond the zone which they wished to reach, and had lost themselves in a glacial region. The pitiless cold which reigns in the higher regions of the atmosphere seized them at the moment when the fire which, useless for rarefying the air, had been extinguished might have served to warm them.

Zambeccari and one of his companions fainted; the third, who had, it appears, taken some alcohol to sustain his courage, alone preserved some little sensibility. When the two who had fainted came to themselves, the unmistakable noise of waves revived them to a sense of their position. The wind which was driving the balloon was, alas, no longer from the south-west, as was the case when they started. The balloonists had penetrated into a current of air which was being driven impetuously from the north. It was this north wind that had paralysed them, and, during their sleep, driven them in the direction of the Adriatic Sea, which would inevitably swallow them up.

The car touched the waves; already the waters of the Adriatic entered through the slender basket-work. Immediately panic seized upon the aeronauts; they blindly cast out everything they could lay their hands on. Without reflection, without consultation, without saying a word to each other, they threw out ballast, instruments, victuals, clothing, the very fuel intended for the montgolfiere. The machine thus lightened bounded upwards with frightful rapidity. The one who had applied himself to the bottle was the most sensitive to the effects of the consequent depression; he was seized with vomiting, and his blood flowed in considerable abundance. Zambeccari and his other companion again fainted.

The balloon again fell, and this time it seemed as if nothing could save them from the waves. During the second ascent the balloon had reached a height so enormous that Zambeccari could no longer make use of his hands; the terrible cold had frozen his fingers. The canvass was almost entirely emptied of gas, or rather rarefied air, so great had been the dilation caused by the rarefaction of the air above. However, there remained enough of gas to enable the car to float. The balloon was driven along the surface of the sea, among the waves, with such a giddy rapidity that the unfortunate aeronauts knew not in what direction they were being borne.

When daylight appeared, in spite of his dreadful sufferings, Zambeccari, who had sailed the Adriatic in all directions, was able to make out his bearings. He perceived that they were some miles distant from Pesaro, in sight of the coast, to which the wind was bearing them with great rapidity. But at the moment when these unfortunate voyagers flattered themselves with the hope of reaching shore, a squall of wind caught them and drove the balloon out again to sea. There were many vessels about, but they kept at a distance, as if terrified by the strange appearance. Happily, the captain of an Italian vessel, more daring than the others, made for the balloon. When he was near enough he sent off a boat, which after a long chase succeeded in rescuing the three shipwrecked balloonists.

In spite of all the warnings he had got as to the danger attending the lamp which he carried as part of his apparatus, Zambeccari resolved to make still another ascent with it: it was his last. On September 21, 1812, he, along with a companion, Signor Bonaga, made an ascent from Bologna. On coming down the grapnel caught suddenly in a tree, producing such a shock as to overturn the lamp and set fire to the whole machine. Zambeccari and his companion leaped from the car; the former was all but killed on the spot, but the latter, though fearfully injured, escaped with his life. To add to the horror of the scene, it is said that Zambeccari's wife and children were among those who witnessed the sad catastrophe.

As a relief from this tragedy, let us turn to the somewhat ludicrous misadventures of a flying man, the first who had made his appearance since Blanchard utilised his wings to ornament his balloon. This successor of Icarus was a watchmaker of Vienna, Jacob Deghen by name. Deghen was no radical wishing to conquer the air by force of wrist; but not being able entirely to dispense with the balloon, he determined to make as little use of it as possible, only adopting what he could not afford to reject.

Deghen had not always been so reasonable, if we may believe his own story. He pretended to have made at Vienna a successful experiment in the court of a prison where he was confined as a debtor. The brave watchmaker would have fled far away from his undesirable captivity had his prudent gaoler, putting little trust in the good faith of the artificial bird, not held him by the foot with a string fifty feet long. This wonderful result was produced by means of large surfaces arranged umbrella-fashion. But the operator, exhausted by the efforts which he had to make, could not sustain himself in the air longer than two minutes. He then thought of lessening the difficulty of his task by making use of a small balloon, to which he gave just enough ascensional force to float in the aerial ocean.

A first ascent was made in the Gardens of Tivoli, Paris. "The apparatus," says Dr. Hartwig, "consisted of two principal flaps, which were fastened to a yoke round his neck, and provided with a mechanism which was set in motion by the hands and feet, and served to raise and depress them like the wings of a bird." Deghen then agitated his enormous bat-like wings, which had a spread of not less than twenty-two feet. The roc of the 'Arabian Nights' could not have had a more terrible flight. In spite, however, of efforts worthy of a better cause, Deghen could not help being the slave of the wind. The descent took place at Chatenay, where the aeronaut was received with the greatest cordiality. The *Journal Officiel* acknowledged his good faith and his talents. He may be said, then, to have come out of this difficult ordeal with the honours of war.

But Deghen was ambitious of again trying the experiment in public in the Champ de Mars, where so many aeronauts had already come to grief. The globe, perhaps badly inflated, refused to raise the inventor of this beautiful apparatus, and carry him away from the irritated public that crowded the arena. Deghen was more rudely treated than if he had made a badly-managed descent, and, in spite of the protection of the police, he was lucky in escaping without his apparatus, after being well pummelled by the disappointed crowd. The treatment seems to have disgusted him with aeronautical experiments, for we hear no more of the chimerical watchmaker of Vienna.

The mania for simplifying the car cost a professional aeronaut still dearer. Monnesent had continued at Lille the experiments which Blanchard had begun in 1785. He let down animals, which fell by parachute like the dog of the celebrated aeronaut. But, in order to be able to lessen the size of the balloon, he contented himself, as a substitute for the car, with a simple plank on which to rest his feet. He had already made, without accident, a great number of ascents with this terribly risky apparatus. On April 7, 1806, he set out just as he had been accustomed to do; but, from some cause or other, he lost his balance, and was found half buried in sand in one of the ditches near the town.

Montgolfieres continued for a considerable time in use in some districts of France. On November 25, 1802, they cost the life of a poor fellow named Olivari, who was making his first ascent. Olivari had devised an economical means of making his aerial *début*. In fact, this simpleton madê use of a simple paper montgolfiere, attached solely, for the sake of form, to a few strips of cloth. The car was of basket-work, suspended underneath the fire, and was filled with combustible material with which to supply the latter. A spark fell, and this frail equipage became the prey of the flames. Precipitated violently to the ground, the unfortunate aeronaut was horribly mangled.

A German named Bittorf made several ascents in 1807 in a montgolfiere. On July 17, 1812, he made an ascent at Mannheim in pretty much the same style as Olivari did at Orleans. He attached himself to the tail of a paper montgolfiere. The machine caught fire, and, like the unfortunate Frenchman, he was precipated to the ground.

Other aeronauts simplified still further the management of a montgolfiere, contenting themselves with placing an envelope above a fire which served to inflate it. When the air was sufficiently heated, they seized hold of a sort of trapeze attached underneath the simple balloon. Immediately the balloon was let go; it shot into the air like a rocket; but as it rose it gradually cooled, so that at the end of two or three minutes it commenced gently to descend. This kind of exercise was continued by a man of the name of Kirsch for some time. As the envelope formed a parachute, it would seem at first sight as if no great danger attended the ascent; yet this kind of experiment cost the lives of many persons. Two brothers named Brachet, who gave exhibitions of this kind in the South of France and Algeria, both perished by precipitate descents which they were unable to master.

To this period belongs a notable improvement of the parachute. Robertson got his pupil Michaud to make a descent at Vienna; but instead of trusting him with his balloon, he placed the experimenter underneath the car, and detached him when the signal was given by cannon-shot. The balloon continued to ascend without accident, for Robertson pulled the valve wide open in order to allow a quantity of gas to escape sufficient to counterpoise the detached weight of the man and parachute.

Since this beautiful experiment, there is no aeronaut who may not perform simply and surely a graceful manœuvre, suppressing, so to speak, all danger. If the cord be suddenly cut as the balloon is ascending, it will take a certain time before the folds of the parachute open. By the time they begin to act, the apparatus has already acquired a dangerous speed. The experimenter at first falls like a stone, and his downward movement only slackens in proportion as his parachute opens out. The adventurous occupant of the car will be lost should his apparatus not work regularly. The spectacle is quite different when the balloon itself has begun to descend. The folds then open out gradually, and it is only when they have expanded to the full that the apparatus is abandoned in space. It then descends gracefully and with a sort of majesty. The aeronaut has it even in his power to moderate his fall if he finds himself about to descend upon a dangerous object.

Robertson no doubt took advantage of this new arrangement only to avoid placing himself in the parachute, and in order that he might not for an instant be separated from his silk balloon. He also professed to be the inventor of an important improvement, because he surrounded his car with a light taffeta which opened out, and thus also acted as a parachute; but this insignificant adjunct has never been adopted.

It was in 1804 that the experiment took place which failed to bring ample rewards, unanimous applause, or rich presents.

CHAPTER XXI.

FEMALE AERONAUTS.

AERONAUTICS fell quite under female sway during the period between 1810 and 1830. In fact, ascents by women were so brilliant and so numerous that one might have been led to conclude that the male sex had been banished from the sky.

Although Madame Thible, the Sisters Simonnet, Mrs. Sage, and Mlle. Célestine Fleury had preceded Madame Blanchard, the latter must be regarded as the first of female aeronauts; for before her no daughter of Eve had made the aeronautical art a regular profession. A somewhat romantic story is told of the birth and espousal of Madame Blanchard, but we need not repeat it here. It was ten years after her marriage before she could make up her mind to accompany her husband into the air.

In 1805 Madame Blanchard made her first ascent alone. As she was very short and very slender, the balloon which she constructed for her personal use was of very small dimensions. Her car was so light and fragile as to make one giddy to look at it; it had been called a child's cradle. The car of Venus might have been more graceful, but it was not more aerial. These circumstances added to the attractions of the experiment and diminished the expense. Although Madame Blanchard used pure gas for inflating her balloon, she never spent more than 40*l.* for each experiment. Thus she soon was able to accumulate a little fortune.

She liked to make ascents at nightfall, a time when the winds are supposed by aeronauts to be quietest and when the public could assemble at their ease. She acquired such intrepidity that she only descended when day had appeared. She preferred to sleep in the car, where she was sure no one could come to disturb her. She dreaded descending in unknown places where the least noise would make her tremble like a leaf; for this truly astonishing woman was strangely timid on the earth. She dreaded riding in a carriage, fearing that every instant it would be overturned. If railways had existed in her day, she would probably have never consented to make use of them.

When Garnerin fell into disgrace, Madame Blanchard became the favourite aeronautical performer at public fêtes; for, in spite of imperial antipathies, balloons had become a necessary accompaniment to every public celebration.

On June 24, 1810, on the occasion of the marriage of the Emperor Napoleon with the Grand Duchess Maria Louisa, the Guard held a fête in honour of their sovereign. Napoleon took his place, along with his wife, on the balcony of the Military School, and followed the ascent of Madame Blanchard with the greatest interest.

Madame Blanchard was not the only queen of the air; she had dangerous rivals in the women of the Garnerin family. Eliza, daughter of the elder Garnerin, was a beautiful woman, whose appearance presented a complete contrast to that of her rival, to whom nature had given the complexion of a bird. She visited foreign countries, and especially Spain, where she had a bone to pick with the Corregidor. One of her ascents having failed, Ferdinand VII., who was never ready to listen to reason, caused both father and daughter to be thrown into prison.

Eliza, on her return to France, wrote or signed a violent pamphlet in which she protested with indignation against the treatment to which she had been subjected. Ferdinand VII. could not remain under so grave a charge, and caused one of his retainers of the pen to write a reply not less lively. The defender of the King of Spain maintained that Eliza could not start because the father did not know how to prepare pure hydrogen gas by the decomposition of water; that he had calumniated the authorities of Madrid by pretending that they were opposed to her experiment; that his Catholic Majesty had put father and daughter in prison in order to protect them against the fury of the people, and also to compel them to return a portion of their fee.

Madame Blanchard was apt to reckon too much on her good luck and presence of mind. Having once allowed her balloon to go too high, she had almost been frozen to death in a cloud of crystals so fine and so tenacious that they stuck to her face. On another occasion, in the course of 1818, she opened the valve without thinking of what might be the nature of the ground below, and having fallen on the top of some large trees, she remained perched there until some peasants came to her assistance.

Although she never attempted to descend in a parachute, Madame Blanchard, to her misfortune, was tempted to follow the example of the Garnerins, and often illuminated her balloon, sometimes with coloured glasses, sometimes with fireworks. On July 7, 1819, there was a crowd at the Tivoli Gardens. A bombshell gave the signal for ascent. The trees were suddenly illuminated by Bengal lights. Madame Blanchard ascended to the sound of brilliant music. The balloon drew after it an immense star which had been lighted. Faggots like those which were burning in the garden were lit, and the balloon illuminated by mysterious fires glided across the sky like a passing meteor.

Soon there falls a shower of gold which seems to come from the car. Frantic applause from below reaches the ear of Madame Blanchard. The brave aeronaut is seen to stoop; she lights with a port-fire a bomb of silver rain, which being suspended to a parachute, descends with supernatural majesty.

Unfortunately the balloon, which always continued to ascend, allowed quantities of gas to escape. An unseen jet is lit by the stick. A train of fire shoots out; the balloon is in flames. An enormous jet issues from it. From all parts below the plaudits are redoubled.

But Madame Blanchard is far from sharing the enthusiasm of the ignorant crowd. With a coolness which few men have ever shown in a balloon, she tries to put out the fire. Not succeeding in this, she throws out all her ballast in order to moderate her descent. The unfortunate woman is seen looking down through space, trying to discover towards what point pitiless gravity is about to precipitate her.

Thanks to her presence of mind she will be saved, for the gas, driven back by the sudden increase of pressure, soon re-enters the interior of the balloon and extinguishes itself. There was then in the suburbs near where the balloon was, large gardens where an aeronant might descend without danger. But the wind drives her on to the roof of a house against which her frail aerial bark strikes, and is overturned. At the moment of the shock, which is not violent, Madame Blanchard is heard to cry "A moi!" ("Help!") But the last hour of the unfortunate daughter of the air has come. In gliding over the roof, her car encounters an iron cramp and is overturned. She does not expect so sudden a shock, and therefore has not been holding on. When the people come up, the car and the balloon are still suspended on the roof, but Madame Blanchard, stretched on the pavement below, with broken shoulder and broken head, is breathing her last.

The body is carried to the Tivoli Gardens. Immediately the music, the dancing, the singing, the illuminations are stopped; a sudden fear seizes the servants; some take to flight.

A subscription on the spot realised a good round sum. It was not, however, continued, as it was learned that Madame Blanchard had left a small fortune to the daughter of a friend. The funds collected were employed in raising a graceful tomb at Père La Chaise, instead of being returned to the subscribers, most of them anonymous.

It ought not to be forgotten that balloons were born at the same time as animal magnetism. But it was only in 1852, in the car of the balloon *L'Aigle,* directed by Toutain, that the first experiment was made in animal magnetism in a balloon. In the car were Mlle. Désirée Purchois, a somnambulist, and M. Rovere, a magnetiser. The results were nil, although the balloon reached the unusual height of 12,000 feet; and we have never heard of the experiment being tried again.

In 1838 the Paris Academy of Sciences actually accepted, with ludicrous gravity, a paper by M. Marey-Monge, on the construction of a copper balloon, intended to hold gas. The construction of this immense saucepan was realised by M. Depuis-Delcourt, the founder of the French Aeronautical Society. Still, though Depuis-Delcourt lent himself to this chimerical scheme, he was not devoid of practical knowledge. It was he who introduced into France the practice of filling balloons with common gas. Before abandoning the use of pure hydrogen, Dupuis-Delcourt tried an economical method of preparing it by decomposing steam by passing it over superheated charcoal. But the enormous quantity of carbonie oxide contained in the hydrogen soon produced poisonous symptoms. A current pressed out of the balloon by its dilation rendered the aeronaut insensible, and he reached the earth in a fainting condition.

Some years after this (September 8, 1850) common gas caused a much more terrible catastrophe. Lieutenant Gale, who had belonged to the English merchant service, made for the first time an equestrian ascent at Bordeaux. The experiment was successful, but Gale could not make the peasants, who sought to help him in his descent, understand him. A false move could not be avoided, and the balloon flew off as soon as the horse was detached. On the morrow the balloon was found caught in a tree, but it was only after several days that the body of Gale was found in a wood almost eaten up by wolves. Gale, overcome by cold and asphyxiated by the current of gas, must have reached the earth dead. His body had fallen through a hole made in the bottom of the car to enable him to ascend into the latter after he had finished his equestrian exercise.

This unfortunate man left a widow and six children. M. Prosper Meller, a Bordeaux aeronaut, came to their help by making a grand ascent, the proceeds of which were very considerable.

It was about this time also that Colonel Lennox, of the old French Imperial Guard, made an experiment with a controllable balloon 150 feet long and 50 feet in diameter, which he named *L'Aigle.* It was made to hold seven passengers, among whom were to be the Colonel's wife, a lady friend of hers, and Ajasson de Gransagne, a scientific writer then very popular. The balloon having been made elongated in the proportion of three to one, it was supposed that a moderate power could impel it in any direction against the motion of the air. It carried a rudder both before and behind. The moving power consisted of paddle-wheels like those of steam-vessels.

Unfortunately, the Colonel conceived the fatal idea of inflating his balloon at the Grenelle gasworks, and transporting it thence to the place of the intended ascent. When it reached the Champ de Mars, *L'Aigle* was perfectly useless. Colonel Lennox had rendered himself obnoxious to the party then in power in France, and on the failure of his scheme, the crowd rushed upon the balloon and tore it in pieces. The unfortunate Colonel, baffled and ruined —for he had ventured his all upon the experiment— soon died of grief.

CHAPTER XXII.

EXPERIMENTS AND TRAGEDIES IN ENGLAND.

We have already spoken of some of the early ascents in England, which, however, is hardly a broad enough theatre for aeronautical experiments. Even when starting from the centre of England, an aeronaut is soon liable to imitate the example of General Money, and finish by descending in the ocean. Even St. George's Channel, though six or seven times wider than the Straits of Dover, is soon crossed. It was crossed successfully on two different occasions, first by Dr. Potin, and afterwards by Mr. Windham Sadler, on July 22, 1817. Sadler's father, Mr. James Sadler, had attempted the same feat about five years before, and had nearly succeeded, when, in consequence of a change in the wind, he was compelled to descend in the sea, off Liverpool. Sadler senior was one of the earliest native English balloonists, having made an ascent, probably not his first, as far back as 1785.

In the course of 1823, Mr. Windham Sadler met with two serious accidents which a more prudent aeronaut would have regarded as serious warnings. His companion forgot to hold on when the balloon came to ground, and was thrown on his back in a field, while the balloon bounded away. In the following ascent, it was Sadler himself who was thrown to the ground. Left to himself, his companion lost his head. Fortunately, the balloon had been torn by the branches of a tree; the gas issued in streams, and the balloon got caught by the top of a neighbouring oak, which Sadler managed to climb and rescue his companion.

On September 29, 1824, Sadler made an ascent at Bolton along with an assistant. On descending at Blackburn the balloon caught in the top branches of a tree, when the assistant got out and the balloon moved on again. It speedily, however, struck violently against the chimney of a house, and the unfortunate Sadler was thrown out and came with such force to the ground that he survived only a few hours.

This same year (1824) is also notable in the annals of aerial navigation, for a memorable tragedy in connection with which a romantic but improbable story is told. Lieutenant Harris, a naval officer, somewhat advanced in age, made an ascent from London on May 25 of this year. Harris seems to have been of a somewhat ingenious turn of mind. Wishing to shorten the time that it took to empty a balloon of its gas, he devised the plan of placing an ordinary valve in the centre of a very much larger one, the latter only to be made use of on the ground for the purpose of emptying the balloon instantaneously. Accustomed to the comparative rigidity of nautical manœuvres, the inventor did not make allowance for the unusual flexibility of the aeronautical globe.

Harris thought he had managed capitally by attaching to the hoop the cord of the great valve, in order the better to distinguish it from the small one. When he wished to descend, he opened the small valve without perceiving that the cordage of the large one had tightened. He had unwittingly opened the immense leaves of the valve, and there can be no doubt of the cause which precipitated the balloon to the ground. The idea of Harris was excellent; a slight error in carrying it into practice inflicted upon him a cruel death.

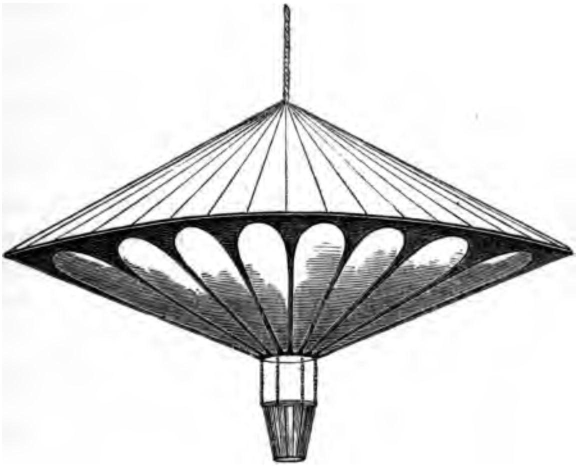
Harris was not alone in the car; he had with him a lady of whom he was exceedingly fond. Not being able to account for her escape, the chroniclers relate that Harris threw himself out of the car to lighten the balloon. This sounds very romantic, but the English journals of the time make no reference to it whatever. It is probable that Harris, who was arranging the cords of his valves, was attacked by the current of gas which issued from the balloon: thus rendered senseless, he was dashed to the ground; his companion being lighter and having the elasticity which life gives, escaped with a few insignificant bruises.

The taste for ballooning was carried by the English to their possessions in India. An English aeronaut of the name of Knight, made some ascents from Bombay. A neighbouring rajah offered him a considerable sum to make an ascent on a day when the wind blew in the direction of the sea. Perhaps the rajah wanted to enjoy the pleasure of a sensational tragedy; if so, his highness's wishes were gratified.

Knight, who saw on the horizon numerous fishermen's boats, boldly accepted the offer. He jumped into his car and the wind drove him out to sea. He very soon opened the valve in order to descend to the surface; but on seeing the strange object approaching their frail barks, the poor Indian fishermen were seized with terror, and speedily fled out of reach of the aeronaut. Knight, his balloon, and the rajah's rupees were speedily engulfed in the waves.

One of the best-known names in connection with the history of ballooning in England is that of Mr. Charles Green, who was born in London in 1784, but does not seem to have commenced his aeronautical career till he was nearly 40 years of age. His first ascent is said to have been made on the day of the coronation of George IV., July 19, 1821, and from that time till his death in 1870, he is said to have made 1400 ascents, and according to one account 6000, though this is not at all probable. To Charles Green are due two important improvements in the management of balloons—viz., the use of common lighting gas for inflation, and the introduction of what is known as the guide-rope, a rope several hundred feet long which is allowed to hang downwards from the car, and by means of which the aeronaut is able to regulate to some extent the height to which his balloon rises. If the balloon sinks very low, a considerable length of the guide-rope rests on the ground, and thus the balloon is lightened and rises again. If it rises too high the weight of the rope tends to bring it down, and thus equilibrium is maintained. Recent aeronauts have dispensed with the guide-rope, though in crossing the sea or making a long journey it would be found very valuable. Modifications of it have since been used. Green, who, it should be stated, had a brother George, also a balloonist, was one of the first to make an equestrian ascent in England. On July 29, 1828, he ascended from the Eagle Tavern, City Road, London, on the back of a favourite pony. In place of a car a wooden platform was arranged underneath the balloon, containing places for the pony's feet, and by arranging straps loosely underneath its body, the animal was prevented from lying down or moving about. On first mounting into the air the little horse became restive as the spectators shouted; but on getting into a more tranquil region he became very quiet, and began eating some beans out of Mr. Green's hand, who dismounted in order to pat his side and quiet him. The balloon rose to a considerable height and got into a shower of fine snow, like silver dust; but at length, having crossed the Thames, it came down, and safely landed the passengers at Beckenham, in Kent, after a voyage of half an hour.

On July 24, 1837, Charles Green made an ascent from Vauxhall Gardens for the purpose of experimenting with a new parachute devised by Mr. Robert Cocking, a gentleman who had for long taken an interest in ballooning, and who had previously made two ascents. The great defect of Garnerin's umbrella-shaped parachute, as Mr. Glaisher tells us, was its violent oscillation during descent, and Mr. Cocking considered that if the parachute were made of a conical form (point or vertex downwards), this oscillation would be entirely avoided; and if it were of sufficient size, there would be resistance enough to check too rapid a descent. It is stated that this form of parachute was suggested to Cocking by seeing an umbrella snatched by the wind from the hands of a friend who was standing at a window, and which fell gently to the ground. The radius of Cocking's parachute was 17 feet, and its weight was over 400 lbs., though the advertisement announcing the ascent stated it to be only 223 lbs. Mr. Cocking's own weight was 177 lbs.



COCKING'S PARACHUTE.

On the above date, then, Mr. Green and Mr. Spencer, a solicitor, ascended in the *Great Nassau* balloon, of which we shall hear more by-and-by, having Cocking and his parachute suspended below the car. "A good deal of difficulty," to quote Mr. Glaisher, "was experienced in rising to a suitable height, partly in consequence of the resistance to the air offered by the expanded parachute, and partly owing to its weight. Mr. Cocking wished the height to be 8000 feet; but when the balloon reached the height of 5000 feet, it being then nearly over Greenwich, Mr. Green called out to Mr. Cocking that he should be unable to ascend to the requisite height if the parachute was to descend in daylight. Mr. Cocking accordingly let slip the catch which was to liberate him from the balloon. The parachute, for a few seconds, descended very rapidly, but still evenly, until suddenly the upper rim seemed to give way, and the whole apparatus collapsed (taking a form resembling an umbrella turned inside out, and nearly closed), and the machine descended with great rapidity, oscillating very much. When about two or three hundred feet from the ground, the basket became disengaged from the remnant of the parachute, and Mr. Cocking was found in a field at Lee, literally dashed to pieces." The horrible story is told that an inhuman innkeeper in the neighbourhood exhibited the mangled body of the unfortunate Cocking to the public at a charge of one shilling; the intervention of the police was necessary to stop so hideous an exhibition.

During this time Green and his companion allowed themselves to be borne upwards in order to observe the effects of the furious bound resulting from the sudden loss of a weight of something like five hundredweight. The balloon shot rapidly upwards, plunging and rolling; the two men crouched down in the car, and Green clung to the valve-line to allow the gas to escape. So rapidly were they borne aloft that the resistance of the air prevented the gas from escaping by the top, and it came rushing downwards from the lower aperture, and would have inevitably suffocated Green and his friend, had they not taken precautions beforehand. They had provided a large bag filled with air and fitted with tubes, and to these they applied their mouths, thus avoiding the inhalation of the deadly gas from the balloon. But even then the gas almost completely blinded them for some minutes, and when they came to themselves they found they were descending rapidly, having reached a height of 23,384 feet, and safely reached the earth near Maidstone.

CHAPTER XXIII.

THE "GREAT NASSAU" BALLOON.

We referred in the last chapter to the *Nassau* balloon, one of the most famous and one of the longest-lived balloons of which record has been kept. This balloon was built by Mr. Green upwards of forty years ago, and we believe is still in working order, and quite recently was used for an ascent by the well-known Mr. Coxwell. We shall now tell how this balloon came by its name, *Nassau*.

In the year 1836 Mr. Robert Hollond, a gentleman who took a great interest in ballooning, resolved to test at his own expense the practical utility of all the discoveries which up to that time had been made in the aeronautical art. For this purpose he arranged for a journey of a length sufficient to answer the purpose in view, and obtained the services of Mr. Green to manage the balloon. With these was associated another gentleman, Mr. Monck Mason. The balloon to be used for the experiment belonged to the then proprietors of Vauxhall Gardens, and, as we have stated, had been constructed for them by Mr. Green. It was pear-shaped, of the finest silk, spun, woven, and dyed expressly for the purpose, and in all respects as perfect as art and experience could then make it. Its height was 60 feet, its breadth 50, and its capacity 85,000 cubic feet; it could raise 4000 lbs. including its own weight. The car was of wicker-work, oval in shape, nine feet long, and four feet broad. It was provided with a seat at each end and a bench in the middle; the bottom was fitted with a cushion, intended to be used as a bed in case of adverse circumstances.

November 7 was fixed as the day of departure on this then extraordinary journey. Provisions and other comforts to last for a fortnight were stored in and around the car, and passports were obtained by the three passengers to all countries on the Continent of Europe. At half past one in the afternoon, all being ready, the balloon was let go, and in presence of an immense crowd collected outside the Gardens, rose gently under the influence of a moderate breeze which bore it speedily away to the south-east, over the cultivated plains of Kent. The weather was beautiful for the season, and only a few light clouds floated overhead, useful as indicating the various winds of which the aeronauts might make use to direct their course. The Medway was crossed at twelve minutes to three, a few miles to the west of Rochester, and in an hour after Canterbury, with its lofty cathedral towers, was sighted. A letter addressed to the mayor, and attached to a parachute, was lowered, and was duly received, though others discharged at different parts of the voyage appear not to have reached their destination. A few minutes after passing Canterbury the aeronauts had their first view of the sea, brightening under the last rays of the setting sun, and occupying the extreme verge of the horizon in the direction in which they were now rapidly advancing. For some time the balloon had gradually decreased its height, and the occupants of the car were delighted with the varied beauty of the country a few hundred feet below, all the features of which could be seen with a distinctness in marked contrast to the vagueness which prevails when viewed from a much greater height. The various objects, which seen from on high appeared like mimic representations of an ideal world, now gradually developed themselves and assumed the character and aspect of reality. The forests and parks, no longer an indefinite mass of something green, opened out, separating into individual trees; the leaves and branches seeming almost within grasp as the balloon hurried over them. So the houses, roads, enclosures, canals and other features appeared in their true colours, while the living forms of nature, before invisible, gave life and expression to the whole.

Their approach to the sea brought the balloon within the power of a current different in direction from that with which it started; it was now clearly tending towards the North, and thus threatened to carry the passengers right into the German Ocean, whereas they wanted to land as near to Paris as possible. By throwing out some of the ballast the balloon gradually rose until it again reached the current blowing to the south-west, which swept it majestically round the horizon, and in a few minutes placed it almost vertically over Dover Castle. At twelve minutes to five the voyagers saw the first line of breakers beneath their feet, but quitted the land with a feeling of perfect confidence in their aerial craft, without the least sense of danger. Mr. Mason, who afterwards published an account of the voyage, describes the prospect which now lay below and around them as impressively grand. Behind them the white cliffs of the English coast sparkled with many lights, the sea below, and far away as the eyes could reach, ruffled with a slight breeze, was dotted with vessels, and glistened faintly as it rose and fell. In the direction in which they were going a dense barrier of clouds seemed to bar progress, like a solid wall fantastically surrounded with a gigantic representation of parapets and turrets, batteries and bastions, and other features of mural fortification. Soon the aeronauts entered the limits of this dark mass, rendered darker by the silence and by the approach of night, and gloomier still as not a sound reached the ears of the voyagers. Scarcely, however, had they realised the novelty of their situation when they saw the well-known lights of Calais and of the neighbouring shores glittering beneath them, and at the same time the barrier of clouds suddenly terminated. It had taken about an hour to cross the Channel; it was now ten minutes to six, and their height was 3000 feet. A suitable lamp which they had brought with them was lighted, and so hung as to avoid all risk of fire or explosion. Preparations were made to pass the night as comfortably and safely as possible, and the central bench was spread with the varied provisions with which the car had been stored. "With many a joke," says Mr. Mason, "touching the *high* flavour and *exalted* merits of our several viands, which, however agreeable under the circumstances, will not bear repeating here, we contrived to do ample justice to the good cheer. We also took the opportunity to prove the efficacy of our newly-invented machine for heating coffee, and found it answer the purpose fully as well as we expected." Unfortunately this last apparatus was accidentally dropped over the side of the car shortly after, and the three balloonists found the flame of the lamp a poor substitute. A drop of "something hot" would, we should think, be unusually welcome in a cold November night at a height of several thousand feet above the earth.

"The scene itself," Mr. Mason tells us, "was one which exceeds description. The whole plane of the earth's surface, for many and many a league around, as far and farther than the eye could distinctly embrace, seemed absolutely teeming with the fires of a watchful population, and exhibited a starry spectacle below that almost rivalled in brilliancy the remoter lustre of the concave firmament above. Incessantly, during the earlier portion of the night, ere the vigilant inhabitants had finally retired to rest, large sources of light, signifying the presence of some more extensive community, would appear just looming above the distant horizon, in the direction in which we were advancing, bearing at first no faint resemblance to the effect produced by some vast conflagration, when seen from such a distance as to preclude the minute investigation of details. By degrees, as we drew nigh, this confused mass of illumination would appear to increase in intensity, extending itself over a larger portion of the earth, and assuming a distincter form and a more imposing appearance, until at length, having attained a position from whence we could more immediately direct our view, it would gradually resolve itself into its parts, and shooting out into streets, or spreading into squares, present us with the most perfect model of a town, diminished only in size, according to the elevation from which we happened at the time to observe it." The city of Liége especially attracted their attention and admiration, surrounded as it was on all sides with the blaze of innumerable fires proceeding from its many iron-works, and which brought out with striking distinctness every street and square and public building.

In this way the three aeronauts passed over Europe, occasionally astonishing the people below by hanging out a Bengal light and scattering over their heads a shower of sand. With the approach of midnight all signs of life departed from below, and nothing but darkness and silence reigned around, the stars only shining with redoubled lustre, "like sparks of the whitest silver scattered upon the jetty dome around us. An unfathomable abyss of darkness visible seemed to encompass us on every side; and as we looked forward into its black obscurity in the direction in which we were proceeding, we could scarcely avoid the impression that we were cleaving our way through an interminable mass of black marble in which we were imbedded, and which, solid a few inches before us, seemed to soften as we approached it, in order to admit us still farther within the precincts of its cold and dusky enclosure. Even the lights which at times we launched from the car, instead of dispelling, only tended to augment the intensity of the surrounding darkness."

The barometer in the meantime seemed to indicate a somewhat unsteady course on the part of the balloon, as if from some cause its distance above the surface were continually varying. The balloon seems, however, to have maintained a pretty constant distance above ground throughout, as was shown by the useful guide-rope, these apparent inequalities not being caused by the actual decrease in the altitude of the balloon, but by the inequalities of the surface of the earth itself. Sometimes the travellers would be sailing over a comparatively level plain, which by-and-by would give way to hills and mountains, their elevation above sea-level thus sometimes reaching 12,000 feet, the extreme height attained throughout the journey.

The cold during the night was extreme, as was shown by the freezing of all the liquors in the car. The voyagers now felt the want of their lost apparatus for heating coffee, and after vainly trying to utilize the lamp, had to give up the use of the beverage altogether. Still they did not experience any unusual discomfort.

As day dawned the varied features of the earth below began to appear, and the travellers were relieved to find that they still hovered over the solid ground. About six o'clock, being then about their highest elevation, they got their first view of the morning sun, and the effect, as may be believed, beggared description. The balloon, in the later part of the journey, oscillated considerably in its level, now bringing them into full view of the sun and again producing for them all the effects of sunset. They now bent their observations and thoughts to effect a safe descent; but although the features of the country below were distinctly visible, they had no idea over what part of Europe they were sailing. Their first attempt to land was in a small grassy vale embosomed among hills, but the force of the wind as they approached the earth nearly brought them to grief among the trees of a neighbouring wood. After a few manœuvres, however, they succeeded in reaching mother earth in safety in a neighbouring valley. They were immediately surrounded by the astonished natives who informed them that they were two leagues from the town of Weilburg in the Duchy of Nassau. It was then about 7 o'clock, and thus they had travelled a distance of 500 miles in 18 hours. The people manifested the greatest enthusiasm towards the three mysterious strangers, increased no doubt by a liberal distribution of brandy and of the cold provisions with which the car was so abundantly stocked. The balloon was taken into Weilburg, and the balloonists were lionized and fêted as if they had been the heroes of a hundred battles. The ladies were especially attentive, and one of their number with all due ceremony bestowed upon the trusty balloon the name of "The Great Balloon of Nassau." After staying in Weilburg a few days, Mr.

Mason and Mr. Green took the balloon to Paris, while Mr. Hollond took the shortest road to England.

Thus then did the "Great Nassau Balloon" come to get its name; and although the journey did not contribute much to scientific ballooning, still we have thought it worth referring to at length as being in some respects the most interesting and remarkable balloon-voyage on record.

Before returning to England, Green made a grand Anglo-French ascent at Paris. Gay-Lussac, then near the end of his career, went to breathe, for the last time, the air of the clouds, under the conduct of the great English aeronaut. There were also in the car a lady named Roscoe, and Lord Yarmouth, and the expedition ended fortunately in the neighbourhood of Vichy. On May 2, 1851, Green again crossed the Channel, in company with the Duke of Brunswick. To the end of the guide-rope, this time, were attached three floats, one above another, and by allowing one or more to dip in the water the height and speed of the balloon were ingeniously regulated.

Very early in his career as a balloonist, Green escaped almost by a miracle from being dashed to the ground through the maliciousness of an individual, who, unfortunately, was never discovered. In an ascent from Cheltenham in 1823, by Messrs. Green and Griffiths, the balloon had only ascended a short distance when the ropes of the car gave way, and the latter would certainly have dropped to the ground had the two balloonists not had the presence of mind to seize hold of the hoop to which the car was suspended. It was found that the ropes had been cut almost quite through, and gave way under the weight of the two men; the car now being suspended by a mere tag. As the ballast fell out, the lightened balloon bounded aloft to the height of 10,000 feet, with the two men clinging desperately to the hoop. Their position, moreover, had the effect of pulling the netting which held the globe away, and soon it began to snap at the places where it was tightest with reports like those of a pistol. The valve-string could not be reached, and therefore the two men had only to wait with what patience they could command until the leaking of the gas would cause the balloon to descend. When at length it did, the material of which it was made was protruding in greater and greater quantities out of the wide spaces left by the snapping of the meshes of the net. Had the balloon escaped from the netting, even at a few hundred feet from the earth, the fate of the anxious men would have been only too certain. The balloon did escape from the netting with a tremendous explosion, but fortunately not till it had reached within a few feet of the ground, and the two men, though greatly bruised and shaken, escaped with their lives.

Mr. Green, according to Mr. Glaisher, may be said to have reduced ballooning to a routine; he had, in his time, more experience in the management of balloons than any one else, and brought to bear upon the subject a great amount of skill and practical knowledge. His ballooning career lasted 36 years, and during that time, as we have said, he made 1,400 ascents, on an average 36 per year. He crossed the sea three times, and twice he fell into it.

We visited Green at Aerial Villa, as he called the fine villa near London where he passed his last years. Aged more than fourscore, the veteran aeronaut had only one passion—his veteran balloon, the *Nassau;* his eyes sparkled with pride as he unfolded the silk of that globe to which he owed fame and fortune.

The celebrated *Nassau* balloon became the property of Mr. Coxwell in the year 1869, Mr. Green wishing his successor to have it before his death, which took place in 1870. Mr. Coxwell has completely restored the silk, and varnished the stout old aerial wonder afresh. He ascended with it in the year 1873, to disprove the theory of a supposed regular and reliable eastern current, Mr. Coxwell proving that no such current can be relied upon.

CHAPTER XXIV.

THE DÉBUT OF EUGÈNE GODARD.

THE name of Godard is one intimately associated with modern ballooning; the family are born balloonists. The first to enter upon the aeronautical career was, we believe, M. Eugène Godard, who made his début somewhere about the year 1848.

As soon as he left school, and while yet almost a boy, his father apprenticed him to an architect; he occupied his spare time in making paper balloons. It took him a year to construct a paper globe twelve feet in diameter, in honour of which the Municipal Council of Batignolle liberally voted him the sum of half-a-crown.

Encouraged by his first successes, which he obtained by means of a chafing-dish, heated with spirits of wine, Godard proposed to the director of the Château des Fleurs to try an ascent with a large montgolfiere, but always of paper. This was the only material which the state of his finances would permit him to make use of. But the young rival of Pilâtre had miscalculated his forces. Abashed by his want of success, he quitted the scene of his failure, and betook himself to Lille, where he at length succeeded in floating for the first time in the air.

The proclamation of the second French Republic, in 1848 gave a lively impulse to ballooning in France. Eugène Godard took advantage of this to construct an immense montgolfiere, but the descent was unfortunate. Godard was associated with a flying man, and fell into the Scheldt.

Another ascent was made, which terminated in the Seine, and had not some sailors fished him out, his career would have come to a premature end. Hardened by the dangers from which he had escaped, Godard went to Boulogne to make an ascent. The wind blew him out to sea, where the sailors once more rescued him from a catastrophe which appeared inevitable.

Perhaps Godard might have been abandoned by this unusual good luck if his good star had not led him to Bordeaux, while Green was there making an ascent. The veteran was interested in the young balloonist, and gave him much wise advice in the construction of an air-balloon, which he named the *Ville de Bordeaux.*

On May 4, 1850, Eugène Godard ascended from the Place de la Concorde, Paris, to celebrate the fête of the Republican Constitution. At that time the inflation of the balloon was a difficult process. It had to be dragged from the Courcelles gas-works, all along the avenue of the Champs Elysées, to reach the place from which the ascent was to be made. These operations were performed with so much ability that Arnaud, the active director of the old Hippodrome, immediately placed Eugène Godard at the head of his balloon service.

Arnaud had considerable taste in the matter of aerostatic displays. It was at his Hippodrome that M. and Mme. Poitevin appeared sometimes in a carriage and sometimes in a mythological costume. It was there that the herculean Thévenin, and latterly Jules Godard, ascended on a trapeze. Green made a very remarkable series of ascents from the Hippodrome. Cheerful, active, intrepid, he introduced into all his aeronautical operations an order and a method which no balloonist has surpassed.

Whether by chance or on purpose, Green descended the second time at almost a hundred yards from the place of his first landing, in the neighbourhood of the College of Juilly. Headed by music the pupils came to welcome the arrival of the celebrated English balloonist. His balloon, the *Continent*, was borne in triumph on a car decorated with the colours of England and France.

Shortly afterwards, Eugène Godard, not wishing to be outdone, made an ascent in a splendid newly-built balloon. In October 1850, the *Ville de Paris* set out at four o'clock with a W.S.W. wind, which led it to the neighbourhood of Ostend. Godard and his five companions, among whom was M. Julien Turgan, editor of the *Moniteur Universel*, reached the earth before nightfall. M. Turgan warmly espoused the cause of balloons, and wrote a very interesting volume on the subject. Another voyager in the *Ville de Paris* was seized with the contagion; this was Louis Deschamps, the manager of the Paris Hippodrome. He determined to become an aeronaut, and prepared to undertake ascents on his own account.

The valve of a balloon is closed by two lids, which open inwards by means of a string passing down through the balloon and out at the lower orifice, in which the neck terminates. A flexible band of indiarubber, which crosses a bridge placed outside, retains the two lids firmly in their places. In order to make the lids more secure, balloonists fold the indiarubber band several times upon itself. Louis Deschamps, in preparing his balloon, forgot to isolate the various strands of his single band. Unfortunately, by a sudden movement, the band broke at one point. Immediately the lids fell inwards by their own weight, and the balloon was precipitated to the ground. Louis Deschamps might perhaps have escaped had he not encountered in his fall a pole, which broke his spine. He was carried home dead in his car.

Godard made an ascent at Marseilles in the *Ville de Paris.* In order to escape an undesirable bath in the Mediterranean, he quietly opened the valve. The people in the car were much bruised. Godard busied himself in attending to their injured limbs, and lost sight of his balloon. A great light caused him to look up; a smoker had set fire to the gas, and the *Ville de Paris* became a victim to the flames.

CHAPTER XXV.

ARBAN'S ASCENTS.

M. ARBAN, born at Lyons about 1820, brought himself into notice while yet a young man, by an adventurous ascent, executed with all the coolness of an experienced balloonist. During the night he bravely crossed the Alps, that gigantic obstacle which even the most daring aeronauts avoid with unspeakable fear. All alone, in a frail wicker basket, he allowed himself to be impelled by the storm which raged when he set off, into the midst of peaks which human foot had never trod. The fantastic light of the moon spread a silver veil over the scene, and cast gigantic shadows from the lofty mountains. A cloud of floating snow threatened to precipitate the balloon into the enormous crevasses of the Mer de Glace. In the midst of his terrible situation a curious idea crossed the brain of this man, who ran the risk of being crushed among the glaciers. He threw out a bottle in order that a fragile waif, falling among the snows, might serve as a witness to future centuries that a French aeronaut had crossed there.

When daylight dawned, a splendid spectacle was revealed to the aerial voyager, who, struggling all night against the fearful cold, had thrown out grain by grain the ballast which was his salvation, and had thus cleared all the peaks, against which the ceaseless storm threatened to dash him. When viewed from below the various branches of the Alpine chain appear a mass of confusion, but looked at from above their summits are seen to be arranged in harmonious and regular lines. Arban, half stupified, contemplated the harmony of these wonderful crests, which as one great whole lay spread out at his feet.

When morning had lit up the plains of Piedmont, he descended to the earth. His descent took place at the village of Pionforte, about four miles from Turin, to which city he was borne by the enthusiastic peasants, and where, in the evening, he received an ovation at the theatre.

Arban was at Trieste a few months later, September 8th, 1846. Wearied with waiting till a storm subsided, he decided to set out in spite of the elements. Unfortunately he had forgot to attend to the gas, and when he wished to ascend he perceived that his car could not be raised. He detached it, and, before any one had time to guess his design, he shot upwards into space, and was borne in the direction of the Adriatic. He was seen standing upon the hoop, saluting the crowd with one hand and holding on to the cords of the balloon with the other. Soon, however, he disappeared, and a thousand boats set out to rescue him, but returned sadly in the evening one after another. No one could see, even in the clouds, any trace of the audacious balloonist.

Arban gradually approached nearer and nearer to the waves, and ended by being dragged through them; for although his balloon had become too weak to carry him in the air, it was still able to tow him. He wandered over the surface of the sea, now engulfed in the waves, and now bounding over them with an irresistible spring. His constantly wet and often frozen limbs, grew quite stiff. In spite of his indomitable resolution and great bodily vigour, Arban could hardly have held on much longer, for night had come on, and the cold of the atmosphere was added to the icy coldness of the sea. But the shipwrecked balloonist, whose eyes could scarcely keep open, heard at last the welcome sound of oars and voices. Some sailors who were coming from the Italian coast had perceived a phantom floating above the crest of the waves; they made all haste to poor Arban, took him into their vessel, and saved his life.

Some years later Arban was at Barcelona with his wife, who shared his aeronautical adventures. As the wind blew seawards Arban did not wish to expose to danger a life dearer to him than his own; he declared that the ascent would not take place. Unfortunately the crowd murmured loudly at being balked of the expected spectacle, all the more enjoyable on account of the element of danger. Arban resolved to set out alone. He set off suddenly as at Trieste, and soon his car, which this time was in its place, was only a point in space. For a long time the Spanish people refused to believe in the death of the heroic man. The rumour spread that he had succeeded in crossing the Mediterranean, but that he had descended in Morocco, where the Arabs had reduced him to slavery. The French Government did not make any attempt to discover the truth of this report; it was only one aeronaut the less. Doubtless, however, Arban's career came to an end in the depths of the Mediterranean.

CHAPTER XXVI.

CATASTROPHES AND CATASTROPHES.

SCARCELY had the details of the catastrophe to Arban become known, than Merle was suffocated by gas on the route from Troyes to Chalons-sur-Marne. As the latter town had no gasworks capable of inflating the balloon, Merle had it filled at Troyes and transported by peasants. Following the example of Captain Coutelle, Merle remained in the car with his assistant, who was very short and, moreover, humpbacked. A squall of wind snatched the balloon from the hands of those who were dragging it, when it rose, expanded, and the gas rushed out. Merle was caught by the current of gas, but the diminutive assistant, whose stature kept him at a distance from the appendix, escaped suffocation. He saw, however, that his companion was sinking, and tried to restore him, but in vain. He, who had never been in a balloon before, found himself face to face with a corpse in the midst of darkness, driven by a furious wind. It was only when he heard a cock crow that he decided to descend, and succeeded admirably. Louis Aubert (such was the dwarf's name) did not receive a single scratch, and the *Majestueux* reached the earth uninjured, bearing its funereal burden.

About the same time (1865) Mr. Chambers, jun., ascended with Mr. Coxwell's balloon from Nottingham, but, contrary to instructions, he allowed the balloon to rise with great ascensional force without opening the upper valve to admit of the escape of gas, which consequently rushed out of the neck, and is supposed to have partially suffocated Chambers, as he clutched the valve line eventually and turned it round his wrist. This was a dangerous thing to do, as it kept the valve open, and hence the balloon came down with great rapidity, and Chambers was killed.

A common error is to trust to the parachute as a means of escape from a perilous aerial situation. A young Frenchman named Ledet, making an ascent from St. Petersburg in the month of August 1847, fell a victim to this mistake. Finding himself above Lake Ladoga, near St. Petersburg, he attempted to effect a descent, but the parachute would not open. The balloon was fished up by some sailors who saw it fall with rapidity, but they could discover neither the remains of the parachute nor the body of the unfortunate Frenchman. The young sister of Ledet, who was present at the ascent, was so affected when she heard of the catastrophe, that she died next day. The father, who was established at St. Petersburg, soon followed his two children. Of all that family there only remained, a month after the fatal ascent, the old mother of Ledet, who retired to Mâcon, her native town, where she lived some time stricken by inconsolable grief.

On September 15, 1851, the aeronaut Tardini made an ascent at Copenhagen. He was accompanied by his son, a child eleven years of age, and by an actress who had requested to be allowed to share the adventure. The immense crowd which covered the shore saw with delight the balloon take the direction of the little island of Anak, which, lying in the Sound, is joined to Copenhagen by a bridge. An upper current soon seized the balloon and drove it rapidly in the direction of the Baltic. Tardini had attached to his balloon a sort of boat which he hoped to launch on the sea if he found himself in danger. The inhabitants of Anak saw with terror Tardini prepare to cut the cords which held his car, his purpose being to set it afloat. But the woman and child, forgetting to hold on, the car was emptied, and the balloon shot into space, carrying Tardini clinging to the cords which he had not yet cut. The two victims who had the good fortune to let go, were saved by boats, but Tardini was never found again.

We could cite many other catastrophes: Piana, who was suffocated with gas at Rome; a pupil of Godard, Pérez, drowned in the Antilles Sea when making an ascent at Havanna; and Emma Verdier, an innocent victim, sent up by a culpable hand in a montgolfiere. The poor girl, clad in white and adorned as for a bridal, fell in a forest near Mont-de-Marsan, where her lifeless body was found in the car.

CHAPTER XXVII.

SCIENTIFIC ASCENTS AT THE PARIS OBSERVATORY.

M. Barral, Lecturer on Chemistry at the Paris Polytechnic School, and M. Bixio, editor of an agricultural journal, conceived the project of ascending in a balloon for the purpose of studying, by means of the most improved physical instruments, a multitude of atmospherical phenomena. M. Arago, the celebrated astronomer, who had invented an apparatus which bears his name, approved of these experiments in an economical fashion, by authorizing the ascent to be made from the garden of the Paris Observatory. The casks for the manufacture of the hydrogen, at the expense of the intending aeronauts, were arranged in the Observatory Gardens.

The first ascent was made with unexpected suddenness and rapidity on June 29, 1850, at twenty-seven minutes past ten in the morning. It terminated an hour after in a vineyard in the commune of Dampmart, near Lagny. The day was a rough one, and the balloon having been badly inflated, and the neck awkwardly suspended near the car, the two aeronauts found themselves entangled in the material which covered them like an immense hood. If M. Barral had not torn the material in making desperate efforts to open the valve, the balloon would have burst, and the two experimenters would have perished. A current of foul gas caused violent vomiting, and incapacitated the two friends from throwing out ballast in order to break the descent. They reached the ground without even having had time to let go their anchor, and, of course, were unable to make any observations or experiments.

The second ascent took place on July 25, at 4 P.M., and the descent at half-past five, in the arrondissement of Coulommiers, about thirty miles from Paris. In order to avoid all disputes as to the height attained, MM. Barral and Bixio took with them registering barometers and thermometers. The ascent was remarkable on account of the extreme cold met with. At about 20,000 feet the temperature was 15° Fahrenheit, the balloon being enveloped in cloud; but on emerging from the cloud, at 23,000 feet, the temperature sunk to – 38° F., or 70° of frost; no less than 53° below that experienced by Gay-Lussac at the same elevation.

Barral and Bixio enriched aerial physics with a new and unexpected fact, for they saw dancing around their car a cloud formed of fine needles of ice, which was in fact the kind of fleecy cloud known as cirrus. In the height of summer it took them less than an hour to find, above Paris, the fine snow which indicates an ultra-polar temperature. These thousands of particles, so beautifully sculptured, radiate from a distance the cold of the impenetrable zones where they are formed. When the mysterious forces which sustain them cease to act upon them, down they come to the surface of the earth in the shape of torrents of rain, causing destructive inundations.

The French Academy do not seem to have paid due attention to the results of the ascent of MM. Barral and Bixio, and further ascents were not encouraged. The Academy of Dijon in vain requested assistance to repeat the experiment of Guyton de Morveau. One of the chief errors, in fact, of official *savants* is the belief that there does not exist any aerial science, that the most insignificant physicist is able to conduct a balloon. As to balloonists who have made a practice of ascending, they seem to be classed in the same category with omnibus conductors. This treatment appears to us signally unjust, for whatever may be thought of the scientific utility of ballooning, it requires no little scientific knowledge, not to mention trained skill, to conduct a balloon ascent efficiently. If balloons had been invented in the time of the witty Dean Swift, he might have been able to add to his 'Gulliver's Travels' a most interesting chapter on the Academicians of Laputa.

CHAPTER XXVIII.

THE EXPERIMENTS OF M. HENRY GIFFARD.

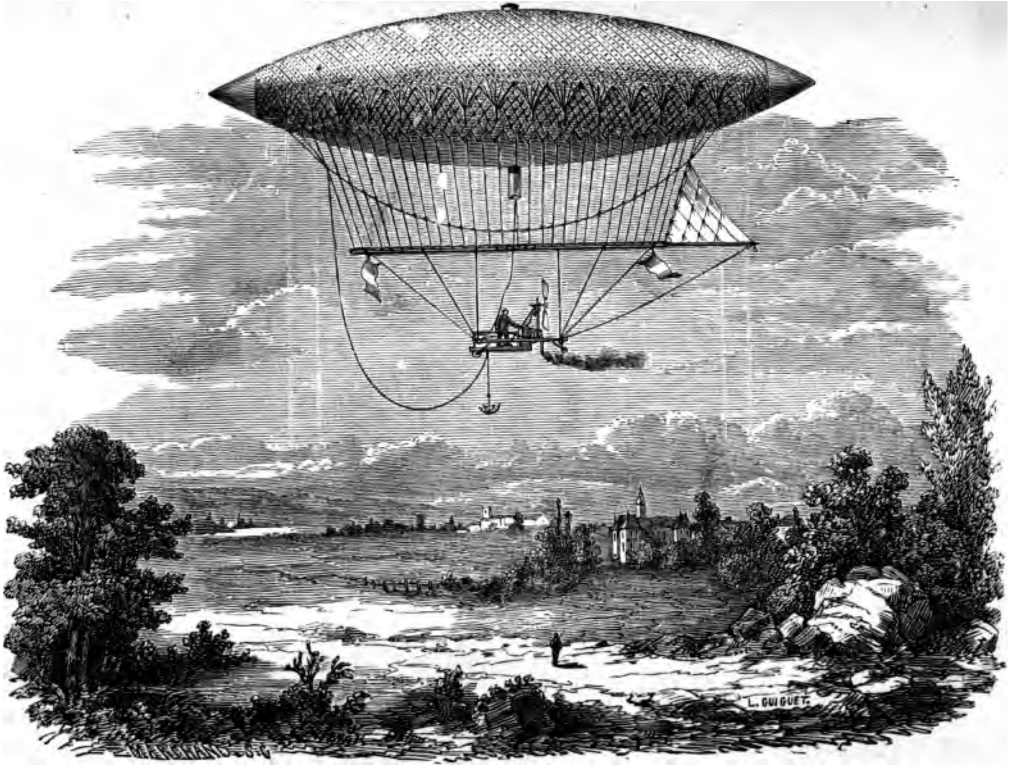
M. Henry Giffard, who has acquired a special position in connection with aeronautics, was born at Paris in 1825, and studied at the Bourbon College. He belongs to the generation that saw the birth of railways at Paris, which took place just as he reached the age of reason. Thus the steam-locomotive, to which he has made the important addition known as Giffard's Injector, has always exercised an invincible attraction over his mind. Attached as a designer to the offices of the Saint-Germain and Versailles Railway, he loved, when his work was done, to mount upon the engines. The whistle was music to him, and he delighted to feel the wind in his face on a train running at full speed. He seems to have got tired, however, of this sensation, and became ambitious of experiencing that of the traveller in the air.

We may say that M. Giffard is the first inventor of a system of balloon direction who has understood the difficulty of the problem to be solved, and who has applied scientifically to his apparatus all the principles of physics and mechanics with which his education and pursuits have familiarised him. He felt that fancy ought to be rigidly banished from aerial constructions, that the form of every bit of tackle, the weight of the envelope and its resistance ought to be calculated as rigorously as if he had to do with a sheet of iron intended for the construction of an engine-boiler.

Before making his experiments, M. Giffard, like a genuine engineer, began by familiarising himself with the aerial medium, and made not less than ten ascents at the Paris Hippodrome, at first along with M. Eugène Godard. Sometimes he set out alone, to the great displeasure of the professional balloonists, who played him more than one trick. One day, when he wished to open the valve, he found the lids had been nailed. Happily the wind was light, and no accident occurred when the balloon, exhausted by the escape of gas, reached the earth.

It was on September 24, 1852, in presence of a numerous public, that M. Giffard ascended in a steam balloon about 140 feet long, 40 feet broad, and 88,292 cubic feet in capacity. The machine, with its water and its coke for fuel, weighed in all less than 4 cwt. The engine had a force of three-horse power, and moved, at the rate of 110 revolutions per minute, a screw of three blades 10 feet in diameter.

As the inventor thought the experiment too dangerous to risk the life of another, he determined to ascend alone, and thus was enabled to take with him a larger quantity of coke and water. Thus, then, sitting in his machine with imperturbable coolness, Giffard struggled against a wind so violent that a steamer would have fled before the storm. The



GIFFARD'S STEAM BALLOON.

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screw in turning produced a deep sound, and the material of the balloon swelled out under the effort. The cords attached to the balloon inclined to one side, and the aerostat itself veered round each time that the aeronaut moved his rudder.

Enthusiastic at this attempt, the value of which was increased by the memories of Pilâtre and Zambeccari, M. Emile de Girardin, who was present at the ascent, published next day in the *Presse* an article urging the Government to advance a million francs for the purpose of speedily solving the problem of aerial navigation. In vain, however; though had the future been foreseen, France might have felt it to be her interest to carry balloons to the greatest perfection possible. As M. Giffard did not return to the spot from which he started, the experiment was considered a failure. This memorable ascent ended at Trappes, where M. Giffard, owing to the darkness, was obliged to land.

M. Giffard had a contract with M. Arnaud for twelve experiments which promised advantageous results. But the days were getting shorter, and the gas company feared they would not be able to supply both the Hippodrome and their regular customers; thus the experiments so well begun had to be dropped.

As we have already said, we owe to M. Giffard a magnificent invention—the Injector; an invention which will perpetuate his name, and which has brought him a fortune of several million francs. Absorbed in completing this invention, and in a multitude of researches of various kinds, it was only after several years he was able to resume his aeronautical studies.

The great obstacle which paralyzes the development of these rational attempts is that, properly speaking, there is no aerial industry. We may admit, in fact, that directable balloons might compete in speed, without difficulty, with trans-Atlantic steamers or railways, but what incredible difficulties would it be necessary to overcome in order to obtain that measure of regularity without which the carrying trade is a chimera? But even if this obstacle were overcome, it is very doubtful if the timid public could ever be induced to renounce railways and steamers for an aerial conveyance.

Meantime, he who will discover a means of exploring the air as easily as is now the case with the depths of the sea, will alone give to aerial nagivation the practical—shall we say commerçial?—character which it still wants, notwithstanding the results of the aerial post during the siege of Paris. It is this new service which M. Giffard has sought to render to aerial navigation since the Paris Exhibition of 1867.

CHAPTER XXIX.

SCIENTIFIC ASCENTS IN ENGLAND.

THE experiments of MM. Barral and Bixio seem to have re-awakened an interest in scientific ballooning in England. Some time after, three ascents were made by Mr. Rush, in company with Mr. Green. These expeditions excited a lively interest, partly, no doubt, on account of the dangers which the balloonists ran. The last descent was made involuntarily in the sea, like that of General Money.

The British Association for the Advancement of Science now took the matter up, and, under the auspices of that body, Mr. John Welsh, of the Kew Meteorological Observatory, made four ascents in 1852. These ascents were made in the *Great Nassau* balloon in company with the veteran, Mr. Green. The object of the ascents was to investigate such meteorological and physical phenomena as require the presence of an observer at a great height in the atmosphere. The ascents were made from Vauxhall Gardens, the charge for admission to the public helping to defray the expense of the experiments. Although Mr. Welsh did not quite reach the height attained by MM. Barral and Bixio, his numerous and carefully-arranged observations are most interesting, and exceedingly instructive. The four ascents were made respectively on August 17, August 26, October 31, and November 10, when the respective heights of 19,510, 19,100, 12,640, and 22,930 feet were attained. Various scientific instruments for observation were taken up, and the lowest temperatures met with in the four ascents were respectively 8°·7 (19,380 feet), 12°·4 (18,370 feet), 16°·4 (12,640 feet), and – 10°·5 or 43° of frost (22,370 feet). The decline of temperature during the ascent was very regular, and, with some modification, confirmed previous observations that a decrease of 1° takes place for every increase in height of 300 feet.

The illness and death of Mr. Welsh paralysed scientific ballooning in England for some years. But in 1858 the subject was again brought before the British Association, and it was decided that some ascents for scientific purposes should be made, a committee to organise the ascents being appointed. The first ascent was to take place on August 15, 1859, from Wolverhampton, which was chosen on account of its being nearly in the centre of England, equi-distant from both coasts. The ascent was to be made in the well-known *Nassau* balloon, with Mr. Green as aeronaut, and two young men, instructed by Mr. James Glaisher, of Greenwich Observatory, as observers. The state of the wind compelled the ascent to be postponed to the 16th August, but again the wind rose after several thousands of feet of gas had been filled in, and the balloon was quite wrecked.

Mr. Glaisher pays a merited tribute to Mr. Green, who was not at all to blame for the failure of this trial, and who was anxiously desirous to see ballooning placed on a thoroughly scientific footing in England.

Another balloon was obtained, the *Royal Cremorne*, of nearly 30,000 feet capacity, and with Mr. Creswick, of the Greenwich Observatory, in it, ascended from Wolverhampton. Little more than a mile was reached, however, when the balloon, a very old one, descended "from sheer inanition," and was found indeed to be full of small holes. This brought the experiments to a close in the meantime, and it was finally arranged that a new balloon should be constructed by Mr. Henry Coxwell, a name universally known in connection with balloon ascents, owing to extensive experience in England and on the Continent.

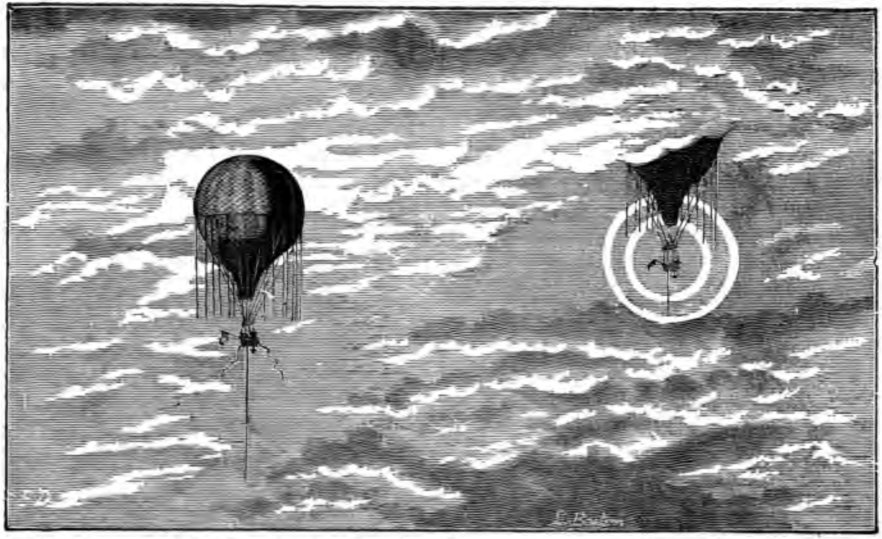
One of the most active spirits in connection with these proposed scientific ascents was Mr. James Glaisher, probably the most thoroughly scientific aeronaut that the world has produced. The sole purpose of Mr. Glaisher's ascents was to obtain scientific observations. He speaks thus of himself:—

"A taste for these studies was first developed during my residence in Ireland, in the years 1829 and 1830. In these years I was often enveloped in fog for entire weeks, first on the Mountain Bencor, in Galway, and afterwards upon the summit of the Keeper Mountain, near Limerick. At this time I was engaged on the principal triangulation of the

Trigonometrical Survey of Ireland, and in the performance of my duty I was often compelled to remain, sometimes for long periods, above, or enveloped in cloud. I was thus led to study the colours of the sky, the delicate tints of the clouds, the motion of opaque masses, the forms of the crystals of snow. On leaving the Survey, and entering the Observatory of Cambridge, and afterwards that of Greenwich, my taste did not change. Often between astronomical observations I have watched with great interest the forms of the clouds, and often, when a barrier of cloud has suddenly concealed the stars from view, I have wished to know the cause of their rapid formation, and the processes in action around them."

Mr. Glaisher has made twenty-eight ascents in all, chiefly in Mr. Coxwell's balloons, the two men being evidently well adapted to work together.

The balloon constructed under the superintendence of Mr. Coxwell was made, not of silk, but of American cloth, being a very strong material. Its capacity exceeded that of the *Great Nassau* balloon, being 90,000 cubic feet, and it is stated to have cost £500. The first ascent by Messrs. Glaisher and Coxwell, under the auspices of the British Association, was arranged for the end of June, 1862, to take place at Wolverhampton; but after the balloon had been nearly filled, it was so knocked about by a strong wind that it split, and the ascent was postponed. The necessary repairs having been made, the balloon was again filled with a specially-prepared gas, and ready for the ascent on July 17. Notwithstanding



AERONAUTS' AUREOLE, SEEN BY MR. GLAISHER.

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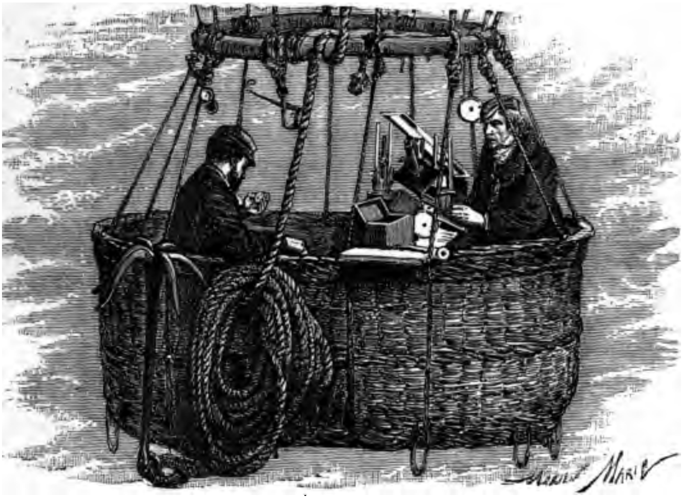
the stormy state of the weather, Messrs. Glaisher and Coxwell resolved to go up, and the earth was left at about 20 minutes to 10 A.M. The greatest height reached was 26,177 feet—nearly five miles—though it was only on reaching a height of 10,000 feet that Mr. Glaisher managed to have his numerous instruments arranged on the specially-prepared table, so violent was the storm. Mr. Glaisher had taken great pains beforehand to train himself to make observations in a narrow space, but he tells us that it was only after frequent actual experience that he learned efficiently to manage his apparatus. Probably more has been learned about the conditions of the upper atmosphere from Mr. Glaisher's observations than from those of all other balloonists put together.

In this first ascent the aeronauts got far above all clouds, and witnessed some magnificent views, the sky above being of an intense prussian-blue. At 12,709 feet a band of music was heard.

The temperatures observed during this first ascent were rather peculiar. At starting, Mr. Glaisher tells us in his 'Travels in the Air,' it was 59°, at 4000 feet it was 45°, at 10,000, 26°, at which it continued to 13,000 feet. The two men had by this time put on additional clothing, expecting, with some justice, that they would soon get into an icy-cold region. But at a height of 15,500 feet, the temperature had risen to 31°, and continued to rise till the height of 19,500 feet was reached, when it was observed to be 42°. They had both thrown off their extra clothing, but no doubt repented having done so, for within two minutes, and after having descended somewhat, the temperature began rapidly to decrease, and in twenty-six minutes it sank to 16°, showing 16° of frost. At 21,792 feet, Mr. Glaisher experienced a feeling analogous to sea-sickness, though the motion of the car was quite smooth.



MR. GLAISHER IN THE CAR.

The descent began a little after 11 A.M., part of it being very rapid—nearly 4,000 feet in one minute having been made. They passed through a dense cloud nearly 8,000 feet in thickness, and the balloon got so weighted with moisture that it came to the ground with considerable force at Langham, near Oakham, in Rutlandshire.

Mr. Glaisher's arrangements for taking observations were very carefully made. He had a specially-prepared table fitted into the car, on and attached to which were about thirty different instruments, all so placed as to be easily made use of. There were a variety of thermometers and barometers, a hydrometer or moisture-measurer, a compass, chronometer, magnet, opera-glass, spectroscope, a Davy safety-lamp (for night ascents), and a variety of other apparatus. In order to avoid breakage by the shock when approaching the earth, the instruments were bundled into a basket anyhow, in layers, with a number of soft cushions between each layer.

Mr. Glaisher made nine ascents from various places, in 1862, with Mr. Coxwell—some of them from the Crystal Palace. He did not always go up in special balloons, but frequently took advantage, as an ordinary passenger, of public ascents from the Crystal Palace or elsewhere. Probably the most remarkable balloon ascent ever made was by Messrs. Glaisher and Coxwell from Wolverhampton on September 5, 1862. It was intended in this ascent to reach as great a height as possible, and the purpose was successfully carried out. The balloon left the earth at three minutes past 1 P.M., when the temperature of the air was 59°, and in thirty-seven minutes a height of four miles was reached, when the temperature was found to be 8°. In another ten minutes they reached the height of five miles, with a temperature of minus 2°—*i. e.* 34° of frost. Mr. Coxwell had been breathing with difficulty for some time, though Mr. Glaisher had felt no inconvenience. On ascending higher, however, the latter began to find a difficulty in seeing clearly, and shortly could not read any of the fine divisions of his instruments. We must allow him to tell the rest himself in his own simple, but graphic, words:—

"I asked Mr. Coxwell to help me to read the instruments. In consequence, however, of the rotatary motion of the balloon, which had continued without ceasing since leaving the earth, the valve-line had become entangled, and he had to leave the car and mount into the ring to re-adjust it. I then looked at the barometer, and found its reading to be 9¾in., still decreasing fast, implying a height exceeding 29,000 feet. Shortly after I laid my arm upon the table, possessed of its full vigour, but on being desirous of using it I found it powerless—it must have lost its power momentarily; trying to move the other arm, I found it powerless also. Then I tried to shake myself, and succeeded, but I seemed to have no limbs. In looking at the barometer, my head fell over my left shoulder; I struggled and shook my body again, but could not move my arms. Getting my head upright for an instant only, it fell on my right shoulder, then I fell backwards, my back resting against the side of the car, and my head on its edge. In this position my eyes were directed to Mr. Coxwell in the ring. When I shook my body I seemed to have full power over the muscles of the back, and considerably so over those of the neck, but none over either my arms or my legs. As in the case of the arms, so all muscular power was lost in an instant from my back and neck. I dimly saw Mr. Coxwell, and endeavoured to speak, but could not. In an instant, intense darkness overcame me, so that the optic nerve lost power suddenly; but I was still conscious, with as active a brain as at the present moment whilst writing this. I thought I had been seized with asphyxia, and believed I should experience nothing more, as death would come unless we speedily descended. Other thoughts were entering my mind, when I suddenly became unconscious as on going to sleep. I cannot tell anything of the sense of hearing, as no sound reaches the ear to break the perfect stillness and silence of the regions between six and seven miles above the earth. My last observation was made at 1h. 54m.—above 29,000 feet. I suppose two or three minutes to have elapsed between my eyes becoming insensible to seeing fine divisions and 1h. 54m., and then two or three minutes more to have passed till I was insensible, which, I think, therefore, took place about 1h. 56m. or 57m.

"Whilst powerless, I heard the words 'temperature' and 'observation,' and I knew Mr. Coxwell was in the car, speaking to and endeavouring to rouse me—therefore consciousness and hearing had returned. I then heard him speak more emphatically, but could not see, speak, or move. I heard him again say, 'Do try; now do.' Then the instruments became dimly visible, then Mr. Coxwell, and very shortly I saw clearly. Next I arose in my seat and looked around as though waking from sleep, though not refreshed, and said to Mr. Coxwell: 'I have been insensible.' He said, 'You have, and I too, very nearly.' I then drew up my legs, which had been extended, and took a pencil in my hand to begin observations. Mr. Coxwell told me he had lost the use of his hands, which were black, and I poured brandy over them."

Mr. Glaisher calculates that he was insensible for seven minutes; returning consciousness came at 4 minutes past 2 P.M., and he recommenced his observations three minutes later. One cannot but admire his self-denying devotion to duty; all his thoughts, even in his then extremely critical position, being devoted to the obtaining observations that would be of value to science.

Mr. Glaisher proceeds:—"Mr. Coxwell told me that while in the ring he felt piercingly cold, that hoar frost was all round the neck of the balloon, and that on attempting to leave the ring he found his hands frozen. He had, therefore, to place his arms on the ring, and drop down. When he saw me he thought for a moment that I had lain back to rest myself, and he spoke to me without eliciting a reply. He then noticed that my legs projected, and my arms hung down by my side, and saw that my countenance was serene and placid, without the earnestness and anxiety he had observed before going into the ring: then it struck him that I was insensible. He wished to approach me, but could not; and when he felt insensibility coming over him too, he became anxious to open the valve. But in consequence of having lost the use of his hands, he could not do this; ultimately he succeeded by seizing the cord with his teeth, and dipping his head two or three times, until the balloon took a decided turn downwards."

Happily no inconvenience followed this strange experience; and after the descent, which took place about seven miles from Ludlow, Mr. Glaisher was able to walk to that town. From very careful observation and calculation, Mr. Glaisher concludes that they must have reached the extraordinary height of 37,000 feet, or upwards of seven miles—two miles higher than the highest mountain in the world, and that within the brief space of one hour.

In an ascent from the Crystal Palace on April 18, 1863, the same two aeronauts had a very narrow escape. The wind in the upper air was blowing very strongly towards the south, and an involuntary start was made at 17 minutes past 1 P.M., the retaining rope having broken. The balloon rapidly ascended, and was driven as rapidly onwards towards the south. In thirteen minutes they reached a height of 10,000 feet, and 24,000 feet was reached in one hour thirteen minutes after starting. It was then thought advisable to descend in order to see whereabouts the balloon was. The descent was very rapid, 14,000 feet having been made in ten minutes. When the balloon descended so far, it got out of the clouds, and Mr. Coxwell, looking over the side of the car, exclaimed, "What's that?" "That" was no other than Beachy Head, and the two balloonists were almost directly above the sea. Mr. Coxwell exclaimed, "There's not a moment to spare; we must save the land at all risks. Leave the instruments." Both of them hung on to the rope of the valve with such strength that it not only opened wide the lids, but made a great rent in the material of the balloon. The latter descended almost perpendicularly; the earth seemed to be rushing up to meet it; and the car came in contact with the earth with such a shock that most of the instruments were shattered, though the aeronauts' lives were saved. The descent of 10,000 feet took only four minutes. A few minutes more and the balloon would have struck the sea.

An ascent from Wolverton on June 26, 1863, Mr. Glaisher ranks among the most extraordinary of his series. The balloon reached a height of 24,000 feet; the weather was stormy on starting, and a cloud was entered at 4000 feet. As usual in balloon ascents, it was expected that the region of clouds would quickly be passed and bright sunshine and a deep blue sky be met with. But scarcely a glimpse of the sun was obtained during the whole ascent, and the clouds were never got rid of during the whole 24,000 feet, when shortness of ballast compelled Mr. Coxwell to descend. The clouds were of very various kinds, and rain and snow were both encountered during the descent. Perhaps the cloudy state of the atmosphere will account for the fact that at a height of four miles the sound of a passing train was heard.

On October 2, 1865, Mr. Glaisher made an ascent from Woolwich Arsenal at 20 past 6 P.M., three quarters of an hour after the sun had set. On this occasion he found that the temperature, instead of decreasing with the height, as is the case during the day time, increased; "on every occasion," he states "the highest temperature was met with at the highest point." Such was the case also with the humidity of the air, apparently indicating that the moisture in the air had fallen towards the earth.

In connection with this ascent Mr. Glaisher gives a graphic description of the appearance of London by night as seen from a balloon :—

"At the earlier part of this ascent I was wholly occupied with the instruments, and when at the height of about 1000 feet the view which suddenly opened far exceeds description. Almost immediately under, but a little to the south-east, was Woolwich; north was Blackwall; south, Greenwich and Deptford; and west, as far as the eye could reach, was London—the whole forming a starry spectacle of such brilliancy as far to exceed anything I ever saw. When I have been at this elevation in the evening, at a distance from London, it has had the appearance of a vast conflagration, but on this night the air was so clear and free from haze that each and every light was distinct, and they seemed all but touching each other. . . . . . .

"On leaving Charing Cross I looked back over London, the model of which could be seen and traced—its squares by their lights; the river, which looked dark and dull, by the double row of lights on every bridge spanning it. Looking round, two of the illuminated dials of Westminster clock were like two full moons. Again, looking eastward, the whole lines of the Commercial and Whitechapel Roads, with their continuations through Holborn to Oxford Street, were visible, and most brilliant and remarkable. We were at such a distance from the Commercial Road that it appeared like a line of brilliant fire, assuming a more imposing appearance when the line separated into two, and most imposing just under us in Oxford Street. Here the two thickly studded rows of brilliant lights were seen on either side of the street, with a narrow dark space between, and this dark space was bounded, as it were, on both sides by a bright fringe like frosted silver. At first I could not account for this appearance, but presently, at one point more brilliant than the rest, persons were seen passing, their shadows being thrown on the pavement, and at once it was evident this rich effect was caused by the bright illumination of the shop-lights on the pavements.

"I feel it impossible to convey any adequate idea of the brilliant effect of London, viewed at an elevation of 1300 feet, on a clear night, when the air is free from mist.

"It seemed to me to realise a wish I have felt when looking through a telescope at portions of the Milky Way, when the field of view appeared covered with gold-dust, to be possessed of the power to see those minute spots of light as brilliant stars; for certainly the intense brilliancy of London this night must have rivalled such a view."

Mr. Glaisher is almost unrivalled as an aeronautical observer. It may be said that he carried with him into the car all the rigid methods of an observatory of the first rank. Nothing is more interesting than to run over the balloon log-books which he has carefully preserved. The pages are covered with figures written in a clear and firm hand. They serve to check and verify each other, and are so regular and consistent as to be trustworthy in the highest degree. Since the ascents of Mr. Glaisher, no observer has attained such a degree of precision in his observations. The figures which he has recorded are the only ones which deserve real confidence, and on which trustworthy calculations can be based. They are the only ones on which physicists place any value, in spite of the opinions of some aeronauts who have attempted to contradict them, and the ill-disguised attacks of observers powerless either to improve upon them or to make them be forgotten.

Mr. Coxwell, besides the ascents for scientific purposes which he has made in company with Mr. Glaisher, has made several hundred ascents on his own account, and is at present the best-known English balloonist. He executed some also on the Continent, and principally at Berlin, where, on one occasion, his wife ascended with him. He was for some time the editor of a valuable paper on aeronautics, where are to be found many interesting documents on his aerial experiences. He has on more than one occasion narrowly escaped a violent death. On July 9, 1847, Mr. Coxwell, accompanied by Mr. Gypson, ascended from Vauxhall Gardens, and had reached a height of 1000 feet when it was perceived that the balloon was much distended. Mr. Coxwell attempted to open the valve to permit gas to escape, but the valve would not act. Shortly afterwards a loud hissing noise was heard, caused by an outrush of gas, which caused the lower part of the balloon to collapse. The balloon began to descend with immense rapidity to the great consternation of some of the passengers. Everything movable was thrown out but with little effect, and the balloon fell to the earth with a tremendous shock, throwing the occupants out of the car and entangling them in the netting and material of the balloon. Fortunately no one was seriously injured, though the consequences might have been fatal had not Mr. Coxwell had the presence of mind to slack the neck cord, and to cause the nearly empty balloon to spread out in such a manner as to act like a parachute and lessen the force of the descent.

On another occasion Mr. Coxwell was engaged to make an ascent at Leicester. The arrangements for the inflation of the balloon were, however, so bad that the passengers could not approach the car, and the preparations for departure were paralysed by a stupid crowd that pressed forward with a vulgar curiosity. As this crowd would not listen to advice, Mr. Coxwell determined to take decisive measures: he opened the valve and allowed the gas to escape into the air. This seems to have quite maddened the crowd. Some roughs threw themselves on Mr. Coxwell and trampled him under their feet; they would no doubt have killed him but for the intervention of the police. His balloon was torn and then burnt; some fragments were carried off as a trophy, and a thoughtless and unfeeling crowd paraded the town, shouting imprecations on the head of the ill-used aeronaut.

The balloon *Research*, which had been constructed by Mr. Coxwell in place of the one burnt, was nearly destroyed before Mr. Glaisher had made any use of it. On July 3, 1865, Mr. Coxwell made an ascent from Belfast, taking with him a number of passengers. The latter, perceiving that the balloon was approaching the sea, became alarmed and pulled so hard at the valve-line that it broke. As they were really close to the open sea, and as Mr. Coxwell had lost control of the valve, there was no alternative but to leave the car altogether. Mr. Coxwell, therefore, gave the command and was, as he thought, the last to quit the car. There were two people, however, left behind, and the lightened balloon bounded upwards to some distance, but soon came within reach again, when the two laggards were got out. The balloon itself, however, escaped at the time, though it was afterwards picked up on the shore of Lurgan Bay, anchored within a few paces of the sea.

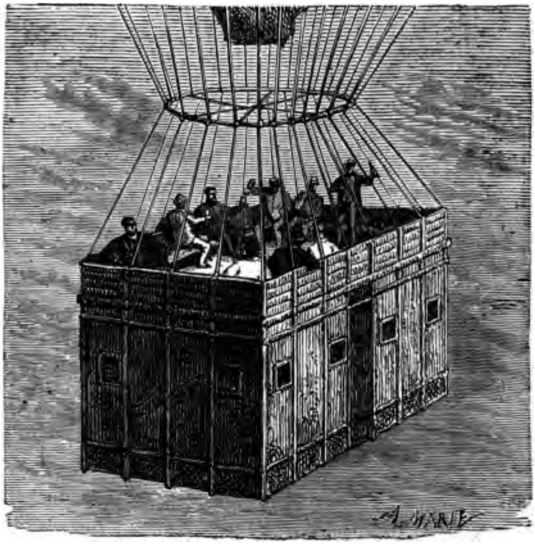
Mr. Coxwell, we may say, comes of a good old family, and besides giving his time and experience, spent a considerable sum of money in connection with the scientific ascents to which we have referred.

CHAPTER XXX.

THE GÉANT.

THE *Géant* was the appropriate name given to an enormous balloon constructed in France during the Empire of Napoleon III., in the year 1863, at the expense of a society established by M. Nadar. The *Géant's* excursions raised an universal emotion. They were almost as sensational as the original Montgolfier and Charles ascensions. They were regarded as public ascents of the highest order. The *Géant* had a capacity of 210,000 cubic feet, and was made entirely of silk. It was upwards of 120 feet in height, of an elongated form, for underneath there was added a sort of appendage, named the compensator, the object of which was to prevent loss of gas during the voyage. This ornament was, however, soon taken away as being quite useless. The car, singularly original in construction, was shaped somewhat like a small cottage. It was in two storeys, 13 feet long by 8 feet high, with berths like a steamer, and stocked with provisions.

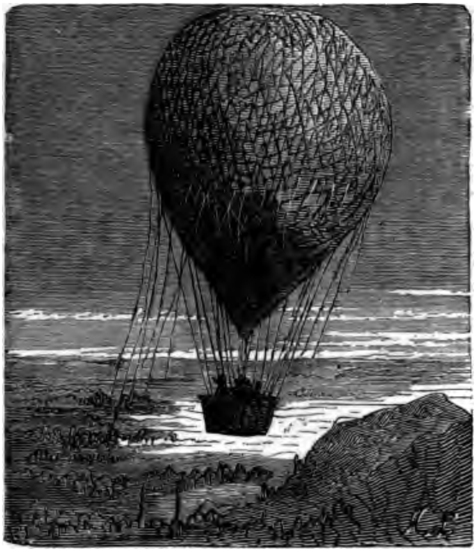
During the years which followed Napoleon's famous *coup d'état,* the Emperor felt it necessary to have his aeronauts and his balloons. He had summoned Eugène Godard to Italy, but the accomplished aeronaut only arrived in time to make an ascent in celebration of the Peace of Villafranca. Eugène Godard's name had become popular, and his dexterity had become unrivalled. It was to him, then, that the construction of the *Géant* was intrusted.



CAR OF THE GÉANT.

The first ascent took place from the Champ de Mars at 5 P.M., on October 4, 1863, in the presence of an immense crowd. The Princess de la Tour d'Auvergne, with Louis and Jules Godard, and ten other persons were in the car. Stores of provisions were laid in, the passengers had arms, guides, and passports in nearly all the languages of Europe.

Scarcely had the balloon risen from the ground when it was necessary to throw out ballast. Bag after bag was thrown out, and the voyage for which such elaborate preparations had been made, ended in a field near Meaux. The cord of the valve was said to be to blame for this early descent. Very naturally, the multitude who remained on *terra firma* laughed at this adventure of M. Nadar's giant balloon.



CATASTROPHE OF THE GÉANT.

A second ascent was made from the Champ de Mars on October 18 of the same year. The balloon disappeared majestically in the direction of Belgium, with Nadar, the brothers Godard, and several others in the car. Napoleon III. came in person to wish a pleasant journey to M. Nadar. Paris heard next morning that a horrible catastrophe ended this aerial voyage.

The sun soon set in grandeur, and the voyagers, grouped on the roof of their osier house, had successively admired underneath their feet the gaslights, like earthly constellations, of Lille, Brussels, and Mechlin. Captain Nadar, armed with a speaking-trumpet worthy of his balloon, woke the echoes of the sleeping earth with titanic shouts. All was going well in the best possible of balloons, when on the edge of the horizon a white streak was seen. This was probably fog, but Nadar immediately pronounced it to be the sea, and in spite of the protests of Saint-Félix, one of the party, "sauve qui peut" became the order of the night. To avoid the still imaginary waves, the balloon was abandoned to the wind, which was blowing stiffly. The cord of the valve broke, and Jules, the youngest of the brothers Godard, made a cut in the side of the balloon. The car came to the ground first near Meriburg, in Hanover, 400 miles from Paris. It did not rest here, however, but was dragged along the ground by the wind-driven balloon at such a furious rate as to cut down trees, and seriously bruise most of those on board. The blind King of Hanover treated the unfortunate balloonists with great hospitality, and as soon as his wounded foot permitted, Nadar returned to Paris, where he was received as if he had been a hero.

Notwithstanding these misadventures, Nadar continued his expeditions at the Hague, at Brussels, and at Lyons. But the ascents were only ordinary voyages, unmarked by any moving adventure. Nadar resolved at last to try London—that great city which all foreigners believe to be so rich, so impressionable, and so sympathetic with daring attempts. The *Géant* was exhibited for some time in 1863-4 at the Crystal Palace, and many thousands of people came to see it, but financially it was not a success. In fact, Nadar's object was to obtain funds to enable him to carry out balloon experiments with a screw, which he fancied would thenceforth supersede all other methods of aerial locomotion. He started a periodical under the name of *L'Aéronaute*, and published a small book which was translated into English under the title 'The Right to Fly.' "Nadar's ascents" says Mr. Glaisher, "had not the remotest connection with science, although he claimed that they had; nor was his knowledge, as shown in his writings, sufficient to have enabled him to have advanced it in any way." In fact, the *Géant* episode seems to have given many people a disgust for ballooning.

During the reign of Napoleon III. several other chimerical projects of aerial navigation were attempted. One inventor exhibited for several years the *Domitor*, a sort of flying machine which was to be sustained in the air by large paper-trumpets or funnels. The *Domitor* was to begin with an honest height of 10,000 feet. It was necessary that the weight of the column of air placed between the funnels and the ground should be equal to that of the apparatus, including ballast and passengers. But the *Domitor* never left the shed where its proprietor exhibited it.

A rival of this genius hit upon the idea of constructing a tubular balloon, to the perimeter of which a great screw was to be attached. An axis passing right through this tunnel served to support a number of persons who were to turn the balloon in the same manner as convicts work the treadmill.

Another chimerical proposal, published with imperturbable seriousness and with a certain enthusiasm, met with a decidedly callous reception. An original genius proposed to establish a balloon service in Paris between the Place de la Concorde and St. Cloud. The balloon was to be attached to an endless cable which was to connect the two stations. A special publication enumerated minutely all the details as to cables, cars, posts, &c. The originator had even thought of a method of clearing the fixed points at which the cable rested upon pulleys. Every contingency was provided for except that in which there was neither money nor shareholders.

The idea of ascending and descending without ballast also engaged the attention of a chemist, who proposed to employ for this purpose a balloon filled with ammonia. This gas having a very strong affinity for water, nothing was easier than to condense it into a small volume when it was desired to descend. To re-ascend it was sufficient to disgorge the water which had been thus saturated. The least touch of a lamp would soon restore things to their original condition, and the balloon could renew its voyage. The difficulty of finding a material capable of holding the ammoniac prevented the experiment from being tried. It remained a project fortunately, and the history of ballooning has therefore to record one wreck the less.

Above everything it is necessary to be perfectly simple in the construction of balloons. The aeronaut should dispense with every superfluous manœuvre, and should not take with him into the air a single strand of cord that can be done without.

There might have been seen on two occasions in Paris a huge flying-fish, provided with fins which the inventor was to set in motion. The inventor's name was Delamarne, half aeronaut, half mountebank. When balloons did not pay, he exercised the calling of incombustible man at the fairs in the neighbourhood of Paris. His balloons were no better than himself; at the Luxembourg his fish lost its equilibrium, and at the Esplanade des Invalides it refused to fly, when the usual rough scene took place.

Delamarne betook himself to London with a rejuvenated montgolfiere, which he was to heat with a mysterious liquid. He was to make captive ascents at the Crystal Palace during an exhibition of the products of aeronautical industry. But the montgolfiere of the incombustible man had an astonishing combustibility. At the first experiment it was reduced to ashes. Mr. Coxwell got up a subscription on behalf of Delamarne, and he returned to France and resumed his experiments of personal incombustibility at the fair of St. Germain. But the poor man fared no better than did his montgolfiere at the Crystal Palace. He was recovering from the severe wounds he had received in the iron cage in which he shut himself to brave the flames, when the Franco-Prussian war broke out.

We may mention here, while speaking of resuscitated montgolfieres, that Eugène Godard made two ascents in this primitive form of balloon at Cremorne Gardens on July 20 and 28, 1864; the only occasion when the people of London had an opportunity of seeing such an ascent. Mr. Glaisher tells us that the air in Godard's balloon, probably the largest aerial machine ever made, being nearly half-a-million cubic feet in capacity, was heated by an 18 feet stove, weighing with the chimney 980 lbs. The furnace was fed by straw, and the "car" consisted of a gallery surrounding it. The inflation did not take more than an hour, and as the balloon ascended, the flames roared up the chimney into the enormous globe above. The trusses of straw were suspended to the car and were drawn up as wanted to feed the flames.

CHAPTER XXXI.

BALLOONS AT THE PARIS EXHIBITION OF 1867.

THE Paris Exhibition of 1867 greatly raised the hopes of aeronauts, but unfortunately they were refused space within the precincts of the ground. Perhaps, had the light-hearted Parisians been able to see a year or two into the future they would have treated the balloonists with a little more consideration. However, notwithstanding this systematic hostility, this exhibition really served to revive aerial navigation, which had languished since the escapade of the *Géant.*

A company, seduced by the prospect of the enormous concourse of visitors which the Exhibition would attract, conceived the idea of bringing anew on the aerial stage this poor old *Géant,* which was now no more than a shadow of itself. At all events the police granted authority for the inflation of the great aerial invalid. This operation took place on the magnificent esplanade between the dome of Louis XIV. and the Palace of the Champs-Elysées. The Paris Observatory even delegated M. Regnault, a member of the meteorological service, to take a passage in it for the purpose of making some observations. Nadar took part in the voyage, to which also the writer of this little volume was graciously admitted.

The departure was rapid and magnificent. Before we had time to realise that we had quitted the earth, we were completely enveloped in mist, and our heads knocked against the thick cloud which at the time formed the roof of Paris. The cloud was so brilliant that it seemed like a condensed light dashed upon the sky, and not a veil of darkness which concealed the splendours of the firmanent. The valve was found to be hermetically sealed; a thick plaster covered all the joints. After half an hour, however, a strong arm weighed down the lids and the balloon began to descend. We scarcely had time to see Bourg-la-Reine pass beneath us when we found ourselves touching the grass of a beautiful meadow. The old balloon seemed to be in bad humour. We landed roughly, the house was overturned, and we fell head downwards. This precipitous and unexpected descent was the ruin of the Society of the *Géant.*

When the old balloon again appeared on the Esplanade des Invalides to make a second ascent, the wind, which had spared us, blew almost a storm. Without respect for its age, the veteran balloon was launched among the trees, but was set free by the expenditure of a few bags of ballast. The car collected a crown of elm branches which it bore triumphantly into the air; but these green trophies cost it very dear. Although slight, the shock was really terrible for the faded material. Dangerous rents showed themselves, and the impalpable gas escaped by a thousand invisible holes. Bags of ballast were emptied in rapid succession, but it was soon felt to be impossible to continue the struggle against gravity. Despair took hold upon us. In less time than it has taken to tell the story, the *Géant* fell to the ground. There seems to be a special providence that watches over aeronauts. More fortunate still than Green, we fell upon a lawn in the midst of the Park of the Oratorians of Juilly. It happened to be the fête-day of the principal, and some of the professors seemed on the point of exclaiming that the catastrophe was a miracle. The Observatory delegate had his foot crushed, and was well taken care of by the good fathers. The incident having made some stir, restored the popularity of the *Géant*. If one of us had had his leg broken, the fortune of the company might have been made.

The third ascent was made in presence of a crowd even greater than on the first occasion. The Prince of Prussia came to see us set off, and I asked him naïvely if he had any commission for Berlin. On board were two friends whose names some of our readers may remember in connection with the communistic struggle in France—Jules Vallès and Paschal Grousset. Eugène Godard was the captain this time, and piloted the balloon to the plains of Champagne, more than 60 miles from Paris.

The departure was preceded by some captive ascents, made with a small balloon carrying two persons, and which, when seen by the side of the *Géant*, appeared a mere infant. The south-west current prevailed to so great a height that the two globes were not out of sight for a single instant. The descent of our fellow-travellers took place at the same time as our own, in a neighbouring field; like us they found themselves near a station of the Eastern Railway. The same train carried next morning the two companies and the two balloons. They met at the station, where they fraternised, to the great astonishment of the travellers by the parliamentary train.

The Flaud workshop, where M. Giffard had had all his Injectors constructed, is situated on the Avenue de Suffren, in sight of the building of the Universal Exhibition. Its appendages comprised a large unoccupied space of ground, on which could be constructed an aerial gaswork. Here was the means of repairing the slight of the Imperial Commission.

These circumstances decided the inventor of the directable balloon to create a special establishment for the execution of captive ascents on the pattern of those which were made at the Meudon aerostatic school. M. Giffard wished to open a new school. He did not want to realise any profits, but he wished the public to bear the expense of those experiments, indispensable to the progressive realisation of his ideas.

M. Giffard organised then, on a magnificent scale, what may be called the first railway station from Paris to the moon. The passengers stopping at nearly 1000 feet above the level of the Seine, advanced but a very brief stage compared with the whole length of the ideal line. However, at a single bound the Giffard balloon shot to a height fifteen times higher than the roof of the neighbouring palace.

The success was immense. Twenty francs were paid willingly for an outing of ten minutes. An eager and well-dressed crowd besieged the car every day on which the balloon went up. Strange to say, the French Institute did not avail itself of the generous offer of M. Giffard to let them have the use of the balloon for scientific purposes, though some gain to the science of meteorology might have been expected from ascents so frequent and so regular.

The Polytechnic School, forgetting that Guyton de Morveau, its founder, was one of the fathers of aerial navigation, would not visit this great aerostatic workshop. On the other hand, large numbers of Germans paid the balloon a visit. The Prince of Prussia, especially, took a great interest in it, and made more than one ascent. He appeared strongly impressed by the magnificent spectacle of the great city which lay extended at his feet. From this splendid look-out a trained eye could observe with wonderful precision the position favourable for an attack on the defences of Paris. In the light of subsequent events it might have been well had the French military authorities taken as much interest in this experiment as did the Prussian Prince and his staff.

Prince Nàpoleon indeed ventured to leave the solid ground, but it is said that he remained all the time seated in the bottom of the car. Two days after the Empress made an ascent, and bravely remained standing all the time, surveying the magnificent spectacle around her. The Emperor had, at least, the desire to imitate her; but he first took the precaution of sending an aide-de-camp as scout, who, not having the hardihood to risk himself in the air, was content with examining the mechanism of the balloon, and made such a report that His Majesty refrained from satisfying the curiosity which seemed to possess him.

The captive balloon of M. Giffard was as high as the dome of the Invalides. It was then, probably, one of the most curious monuments of Paris, for the material was so substantial that it could stand any storm. But its weight was so great that it could never have risen had it not been inflated with pure hydrogen. Never before had aeronauts to prepare so large a quantity of the gas; thus its manufacture was carried to a high degree of perfection. The vats had been made of vast size in order that the liquid should not have to be strongly acidulated. Each contained a large supply of iron-filings, so that it was very rarely that the vats had to be stove in. It required a force of 80-horse power to pull down at a satisfactory speed a balloon which carried 50 persons, with the necessary ballast and tackle required to make an aerial voyage in case the cable should break. But no contingency of this kind happened, and the ascents were universally allowed to have been in the highest degree successful and agreeable.

The windlass was necessarily of enormous dimensions; yet the monster aerostat obeyed the least movement of the directing lever, and that so easily that a child might have worked it. The movements were executed with so little effort that none of the passengers could imagine the tremendous amount of energy that was brought into play. In the following year the captive balloon figured at the Paris Hippodrome, where an incident occurred to interrupt the proceedings in rather a rough fashion. Eugène Godard, who was captain, had organised a series of free (*i.e.*, not captive) ascents for amateurs with the *Ville de Florence* balloon. The accomplished aeronaut felt confident he would be able to effect his departure from the Hippodrome, where the captive balloon was at anchor. He had reckoned, however, without a squall which arose, and which drove the balloon against the captive, the material of which it caught hold of. The captive sank and was empty in an instant.

Aerial navigation was dead as a business in France, yet the success of the captive balloon had been too great in Paris not to attempt the experiment on a larger theatre. I had little difficulty in persuading M. Giffard to repeat the venture on such a splendid ground as London, with which I was well acquainted. He constructed a large balloon, of upwards of 350,000 cubic feet capacity, and sent it to London, where it was installed in a large space near Cremorne Gardens. The workmen who had charge of the mounting and varnishing of the balloon thought they were doing a fine service by greasing the cords of the netting. The grease melting, spread itself over the envelope and penetrated the layer of indiarubber, which was to prevent the gas from escaping. Riddled by thousands of small holes, the balloon was useless. It was necessary to construct another captive.

In order to make up for the mistake of his too-confident men, M. Giffard gave to his new balloon much greater dimensions; it had a capacity of 424,000 cubic feet. It was able to carry in five minutes, thirty persons to a height of 2000 feet above the level of the Thames. The engine that worked it was of 200-horse power.

The London ascents were made from an immense circular enclosure of planks and canvas 575 feet in diameter. The balloon was inaugurated by a banquet at 1000 feet above the Thames. Only a few amateurs, however, seem to have come at intervals to admire a spectacle much more varied than is to be seen from above Paris, for London is a region of clouds of the richest combinations and most varied forms. The light, playing across the great masses of vapour, produces new forms and unexpected decompositions. Suddenly a fresh north wind, quick as lightning, sweeps away these clouds; then the dazzled eye of the aerial voyagers can take in simultaneously the Channel and the sources of the Thames, sometimes even the coast of France and the mountains of Wales.

But daring, and even rash, on the Continent, the English are transformed, transfigured on their own side of the Channel. In seeing these correct gentlemen and irreproachable ladies pass by, you could not recognise in them the indefatigable tourists, the intrepid mountain climbers, whose exploits may be imitated but not surpassed.

An extraordinary accident, which would have drawn to the car of the captive balloon all the British colony in Paris, or Brussels, or Rome, caused the balloon of Ashburnham Park to be deserted. About the end of May 1869, an alarming rumour spread through the great city, and was speedily telegraphed to Paris, New York, Berlin, and St. Petersburg. The captive, it was said, had suddenly broke loose. It had taken with it to the limit of the planetary void thirty persons; thirty victims had disappeared in the inaccessible regions of the atmosphere. Their fate, it was predicted, was certain.

Happily these rumours were all false. The cable had borne itself bravely; the material had never even threatened to give way. The captive had triumphed over the tempest, and was strong enough to face the storm in the very bosom of the clouds. But a stupid oversight had been made by the men who had charge of the working of the captive. Before reaching the windlass the cable passed round a movable pulley, which turned round to suit any wind. By some misunderstanding on the part of the engineer, the rope was allowed to slacken and slip from the groove of the pulley. The balloon rose, and in an instant the rope was cut by the sharp edges of the groove. The captive bounded upwards with a frightful force, to a height, it is said, of 12,000 feet, before one had time to realise that it had left its moorings, and a gust of wind blew it rapidly away. Fortunately no one was in the car, and the balloon was arrested about sixty miles north-east of London in the branches of an oak.

Twelve days after, the balloon, repaired and reinflated, again commenced its evolutions before a public that had foolishly believed all the rumours that had been circulated. It is said that the career of the captive was cut short owing to the complaints of a clergyman who kept a boarding-school in the vicinity, and who was greatly annoyed because the balloon, which could be seen from his windows, proved a much greater attraction to his pupils than the *pons asinorum* or the *Gradus ad Parnassum.*

"The last person who went up in the captive balloon," we are told in Glaisher's 'Travels in the Air,' "was an old woman, aged one hundred years; the same who, on losing her son, aged seventy-five, exclaimed, 'I felt sure I never should bring up that child.' For the last forty years she had been an inmate of the Lambeth Workhouse, and on her hundredth birthday, when the master of that establishment asked her what she would like best on this occasion, replied that she longed to make an ascent in the captive balloon. The car was, therefore, placed at her disposal, and she rose into the air accompanied by some of her ancient friends."

As we have already said, M. Giffard had had the intention of creating, for the purpose of aerial navigation, a sort of permanent fund with the profits arising from the ascents of captive balloons. When he put a stop to the operations of the London captive, he had expended a sum of many thousand pounds, and received only a couple of hundred in return. He had still, however, the desire of making a new experiment, and proposed to construct, at his own expense, a balloon which would make its evolutions in the Champs-Elysées, and rise to a height of 3280 feet. The Emperor, who had been converted to balloons, favoured the scheme. All necessary authority had been granted, and the works were about to commence. It was necessary to disarrange a few shrubs on one of the pastures in the neighbourhood of the Palais de l'Industrie. The project fell to the ground before the opposition of the chief engineer of the plantations of Paris.

CHAPTER XXXII.

FRENCH SCIENTIFIC ASCENTS DURING THE SECOND EMPIRE.

IF the direction of balloons is a complicated question, the exploration of the aerial medium is not less so. The first observers easily perceived a certain number of striking phenomena. It required much knowledge and thought in order to make any advance. The Society of Aerial Navigation, founded by M. Depuis Delcourt, conceived the happy idea of profiting by the ascents at the Hippodrome, in order to send up an observer. After many applications, it obtained a loan of the *Impérial,* which, after being brought back from Italy with the baggage of His Majesty, was rotting in the lumber-room of the Crown.

The aeronaut was Eugène Godard, and the scientific observer M. Camille Flammarion, well known by several popular and interesting works on astronomy. The *Impérial* carried, besides, Count Branicki, a wealthy Polish gentleman, who had become French in heart and spirit.

The first ascent terminated in the Forest of Fontainebleau. Count Branicki contented himself with this single ascent; but if he himself remained on the earth, his money continued to ascend to the clouds, and he became the Mæcenas of these aerial expeditions. M. Flammarion made many observations during his ascents, and afterwards published a picturesque account of them in Mr. Glaisher's 'Travels in the Air.' We may refer to his voyage of July 14, 1867, which terminated in Prussia, at Dallinger, near Düsseldorf, where the *Impérial* descended, after having run a distance of 310 miles in twelve hours. On this occasion Eugène Godard had attached to the car three balloonets, or satellite balloons as they are called. Each of these bore an astronomical symbol, designed by M. Flammarion. The Germans gave the voyagers an enthusiastic reception. They entered Cologne in triumph, preceded by a horseman bearing the French flag. The next balloon which fell on the other side of the Rhine met with a very different fate.

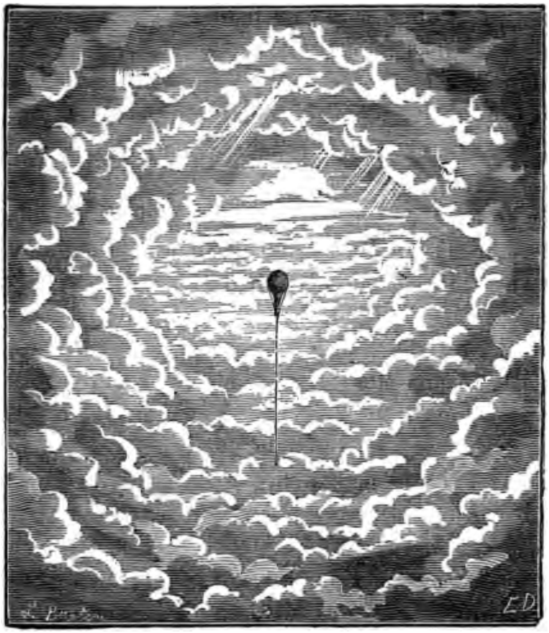
In connection with these ascents, a very ingenious suggestion was made by Count Branicki, when he made his ascent. He advised Eugène Godard to place around the equator of his balloon a girdle of light material, fixed to the car by those cords attached to the circumference of the stuff. It was a sort of circular parachute, which could easily be made of considerable dimensions. By considerably enlarging the size, it would be possible to try, without any other means of moderating the descent, the experiment of Garnerin, and rip the balloon as he did.

As the *ego* is very repugnant when the human atom is speaking of the celestial infinite, and as our space is necessarily limited, we beg to refer the reader desirous of becoming acquainted with the history of our own aerial campaigns to the 'Travels in the Air,' of Mr. Glaisher. We must, however, mention a night ascent on November 16th, 1867, for the purpose of watching the shooting stars.

A little before morning began to appear, Jules Godard, happily for me, perceived the gleam of the lighthouse of Etaples, announcing the approach of the German Ocean, into which the *Hirondelle* (Swallow), as our balloon was called, was hastening to precipitate us. This was a serious warning of the danger of night ascents.

As to the shooting stars, we saw them distinct and clear, and that on a cloudy night when astronomers who remained on the earth had not seen a single one pass. Since then all the academies of the world have discussed over and over again the nature of these bodies; societies have been organised for the sole purpose of observing them; a score of works have been published upon their properties; and no one has again ascended into the air for the purpose of observing them more accurately. I may safely leave to future generations the task of applying that method which I tried, and for inaugurating which I was much abused.

We must again speak of the balloon, the *Entreprenant*, which, thanks to the good-will of Dolfuss-Ausset, of Mulhouse, made two interesting ascents from the gasworks of La Villette. Since then, those gasworks have become a centre of scientific ascents. Thanks to our application, the gas company placed its carbonated hydrogen at the disposal of aeronauts who desired to make ascents. Some widely known aerial tragedies have been originated here, and have much contributed to the popularity of that rich company who, monopolizing all the gas service of Paris, may be said to be jealous of the progress of light.



VAULT OF CLOUDS AROUND THE ENTREPRENANT.

Two of these ascents were made with the brothers Chavoutier, to whom I conveyed a taste for ballooning, and taught the elements of the aeronautical art on a scientific basis. We must also speak of Edouard

Coulomb, the glaciarist, the companion of Agassiz, who explained to the two Chavoutiers the method of tracing the diagrams of aerial voyages. If the cruel malady which carried him off had not kept him fixed to earth, he would have followed his young friend into the air in spite of his age. It was during the ascents of the Chavoutiers that the vault of clouds was observed, of which we give an illustration, as one of the most curious specimens of an aerial landscape that has ever been observed.

Most of our readers, we dare say, will remember the name of Duruof in connection with a ballooning adventure that nearly became a tragedy a very few years ago. M. Duruof, like most celebrated French aeronauts, was born at Paris, and was attracted to ballooning when still young. His father in vain attempted to combat his youthful tastes; the son did not rest until he was admitted among the crew of the *Géant.* He was in Nadar's famous flying cottage at the time of the Amsterdam ascent. He saw himself suspended in the air without any other alternative than the choice between a precipitate descent into the Zuyder Zee and a fall into Haarlem Lake. A providential wind carried the balloon right into Holland, and taught him by experience that a true French aeronaut should never despair.

In the autumn of 1867 Duruof made an ascent at Calais. He set out with a wind that blew inland. But hardly had he reached a height of 600 feet when a north wind sent him right into the Channel. Instead of abandoning himself to despair, and attempting an impossible descent, leading to disaster, he remembered the Amsterdam ascent. He saw a series of graceful fleecy clouds, which were approaching the land. A touch of the valve soon brought him down to the level of these clouds, and the *Neptune* returned to the Continent in joyous company.

Duruof had with him in the car à young man whose ingenuity had attracted him. This young man was a pupil at the laboratory of Dehairain, at the Conservatoire des Arts et Métiers, where I had seen him before. I met him after Duruof's ascent, when he told me what he had seen. He interested me, and I advised him to continue his experiments. Shortly after I proposed to unite our efforts, and we together organised an ascent, the captain being the daring commander of the *Neptune,* and the starting-place the Conservatoire. The young man was M. Gaston Tissandier, now a well-known French man of science, and editor of the French scientific journal *La Nature.*

The expedition was picturesque and instructive, but terminated in a somewhat awkward though amusing incident. A violent wind, reaching to no great height, prevailed at the surface of the ground. We had just encountered a strong breeze caused by the influence of the sea, which drove us with extraordinary violence. Suddenly our anchor got entangled underneath a wall. The cable tightened in an alarming manner, and the balloon was quite flattened between the netting. The envelope opened with a dreadful explosion, similar to that which children make by bursting a paper bag filled with air. We were suspended 230 feet above the ground; it seemed as if it were all over with us; that we would be dashed to the ground and killed. But before we had time to realise our desperate position, we found ourselves lying side by side upon a meadow, where the balloon had deposited us in ludicrous positions, stunned and stupified, but without wound or bruise. By the time the peasants came to pick up our corpses, we were putting ourselves to rights, laughing heartily the while. The material of the balloon, pressed against the netting, had resisted like that of a gigantic kite which takes a header, dragging at its tail three cats which the boys had attached to it.

Some time after, Gaston Tissandier and I were alone in the car of the *Céleste*. A violent wind had driven us on sixty-six miles in thirty-five minutes. Never before or after had any balloonists been borne onwards at such a giddy speed. If we could have remained in the air long enough, as the wind was blowing from west to east, we should have made the circuit of the world in twenty-four hours, and not twenty-four days, like the hero of Jules Verne. But as we had not enough of sand, we were compelled to descend. A furious dragging of the balloon then ensued: after having traversed three forests we were arrested on the edge of a pool where some ducks were dabbling, much puzzled by the new arrival. Tissandier was covered with blood which came from his wounds, so frequently did our heads strike together. The adventure made some noise and increased the reputation of my aerial companion.

The ascent of the *Pôle Nord* made from the Champ de Mars in the month of August 1869, for the benefit of the Arctic expedition organized by

Gustave Lambert, was not without interest. A balloon of 350,000 cubic feet, rising without accident, and descending with equal good fortune after a sojourn in the air of some hours, was a novelty in the annals of aerial navigation. This monster balloon, placed at our disposal by M. Henry Giffard, was no other than the captive of London, with all the damages repaired that it had suffered during its memorable flight. Although the tissue allowed hydrogen gas to filter through, it was impermeable

A BALLOON IN A SNOWSTORM.

enough for ordinary lighting gas, with which it was filled.

The ascent was made from the centre of the Champ de Mars in presence of an immense multitude; but thousands of curious spectators had taken up positions on the summit of the Trocadéro, beyond the reach of the money-collectors. M. Sonrel, the delegate of the Paris Observatory, accompanied us for the purpose of directing the observations. This able physicist had just published a most interesting volume on the "Wonders of the Deep Sea," and proposed to issue a similar volume on the Depths of the Air. But, alas, his first ascent was his last: he was carried off by a cruel disease. Gustave Lambert, who was to have led the polar expedition, perished also, but by the hand of the Prussian.

The expedition in the *Pôle Nord,* which ended at sunset by a fortunate descent, proved that the *Géant* was by no means the largest balloon that could be worked, even under adverse conditions. We should have been able to continue our ascents; but we are approaching the year 1870, a sad year for all Frenchmen. A feeling of vague unrest agitated all minds.

The first months of the terrible year were not fertile in aerial expeditions. However, a small balloon, the *Céleste,* which M. Giffard had constructed for my experiments, afforded Parisians a useful spectacle by which the scientific body might have profited. In fact, the *Céleste,* setting out from the Rue Monge on a beautiful day in June, descended near Bercy, after having zigzagged in all directions.

CHAPTER XXXIII.

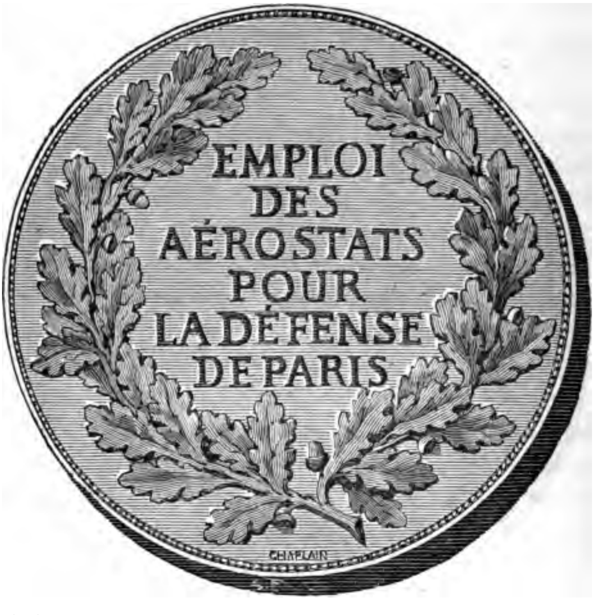
MILITARY BALLOONS BEFORE THE SIEGE OF PARIS.

THE imperial armies, on their departure for Berlin, did not want a single button to their leggings; but they did not possess a single balloon. Although His Imperial Majesty had his aeronaut, it was thought that balloons would only encumber the military promenade which he was about to execute. But, alas, instead of besieging the capital of King William of Prussia, it was too soon evident that all the energy of the French would be required to defend their beloved Paris. A scientific commission was then established, but it seems to have been practically useless. These commissioners did not know even the elements of the aerial art, and imagined they could organize military observations with two worn-out balloons, neither of them of any value whatever. The balloons were anchored at Montmartre and Montsouris, but for all the service they did, they might as well have been exhibited in a covered circus. Probably this fruitless course would have been persisted in, if, just as the Prussians were about to complete the investment of Paris, a despatch had not arrived from the delegation of Tours opening up altogether new horizons. A small balloon, constructed and inflated at the Arsenal of Metz by some artillery officers, had fallen in the neighbourhood of Neufchâteau, a small village in the department of the Vosges. The despatches which it carried having been taken to the sub-prefect, he had them telegraphed to Tours, and from Tours they were forwarded in the same way to Paris. It was thus shown that if the earth failed the French, and the sea refused to serve her, the air was still at her command. The aerial post, in short, had been invented; by means of these small balloons, besieged Parisians, cut off in every other way from the outside world, were yet able to communicate with the latter over the very heads of their enemies.

All messages, before being allowed to leave Metz, were carefully recopied upon small squares of thin paper by secretaries who would not allow any suspicious expression to pass. In these thousands of revised letters, scrutinised with patriotic care, the enemy did not find a single message of which he could make any use.

The balloon which fell at Neufchâteau was only the second that the officers of Metz had sent off. The first, which carried a cage with a pigeon, did not pass beyond the enemy's lines. It fell into the hands of the Prussians, who are said to have eaten the poor bird, and to have sent a flag of truce to the besieged to tell them that their messenger had been found excellent.

Paris, before the siege, possessed a number of pigeon societies affiliated to those of Belgium, and which each year, about the month of June, took part in the carrier-pigeon competitions. Immediately after the declaration of war between Prussia and France, a great competition was to be held at Ruffec, a small village near Bordeaux. But the government gave a prompt proof of the high intelligence by which it was animated. Some sage prefect discovered that the agents of Prussia might provide pigeons and utilize them for mysterious correspondences, consequently the transport of pigeons was interdicted.



MEDAL AWARDED TO THE BALLOONISTS OF THE SIEGE OF PARIS.

At last two hundred pigeons were stowed away in a train about to quit the Orleans station at Paris;

these pigeons were to be taken to various places for the purpose of being sent back to Paris with messages. The man in charge of these pigeons possessed a passport signed, but not stamped. The under-officer of the railway company was inexorable: he could not be responsible for so grave an irregularity: the cages were taken off the train, and the majesty of red-tapeism was vindicated. Scarcely had the train left the station when a fresh order arrived; but, alas, it was too late to send off another locomotive; care had been taken to blow up the bridge behind the train that had just left. There

now remained only balloons for the conveyance of the pigeons. But much ignorance and official slowness and blindness had to be removed ere the besieged Parisians were convinced of the great services which these carrier-pigeons might render them; meantime much precious time had been lost.

Before the terrible year, pigeon-coursing had been a pastime mainly confined to the people. Pigeon-fanciers as a rule occupied humble positions, most of them being working-men. Yet these workmen, of sedentary and inoffensive habits, might have been seen rapidly traversing the air in balloons, carrying their doves beyond the circles of besieged Paris. Some, falling into the hands of the Prussians, expiated in Prussian prisons their patriotic devotion; others, marching with the advanced guards of the army, went to Orleans, to Tours, to Bordeaux, to Brittany, or to the Loire, tending, directing, and sending off the pigeons.

On a similar occasion the Venetians conceived a happy and somewhat poetic idea. Advertised in time by pigeons sent from Candia, they were able to send from the end of the Adriatic a fleet of vessels which saved their precious conquest. The Senate decided that the birds which had rendered such signal service should be set at liberty, and they, as well as their descendants, fed at the expense of the republic. Such, it is said, is the origin of the celebrated pigeons of the place St. Mark at Venice.

CHAPTER XXXIV.

THE FIRST BALLOON POSTS.

It took some time to convince the Parisians that their beautiful city could be blockaded; they hoped against all hope that postal runners would be able to slip through the hands of the Uhlans. But when the sad truth became an undeniable reality, M. Rampont took the necessary measures with admirable promptness. Scarcely ten days sufficed for M. Eugène Godard to deliver over his first balloon. The manufactory was at first established at the Orleans station, but latterly at the station of the Eastern Railway. The sight of these graceful globes tinted in striking colours rendered the deserted arches gay. The balloons were arranged in regular lines along the arrival platforms, and served in a measure to people these solitudes. Another manufactory was organised by Jules Duruof at the Northern Station. But ten days are a prodigious delay when it is a question of putting the capital of a country into communication with the rest of the state.

An aeronautical Curtius was wanted, who would throw himself head-foremost into the gulf of the clouds. Duruof did not hesitate an instant to brave the fire of the Prussians with an old balloon leaking at every seam. An order arrived in the evening, and next morning at eight o'clock the *Neptune* soared above the *buttes* of Montmartre. Duruof perceived that his only chance of safety lay in the force of the impulse with which he started. He therefore launched his balloon like a projectile which issues from a monster mortar. The *Neptune* described a parabola like that of a bombshell whose descent had been miraculously prolonged. By sacrificing seven hundredweight of ballast, the descent took place about nineteen miles from the Place St. Pierre, in the Department of Eure, not far from the Prussians, but still beyond their range. A true son of Paris, Duruof could not let the opportunity escape of enlivening a situation so terrible. He threw *cartes de visite* down upon the heads of the enemy, who, furious at seeing the blockade thus forced, saluted the *Neptune* with a salvo of artillery, and a rolling fire of musketry.

But in order that the defence of Paris might not be a mere chimera, it was necessary that the Delegate Government established at Tours should be able to give an account of the manner in which the orders had been executed. It was the *Ville de Florence* which took, by way of trial, the first pigeons intended for return with despatches. The descent was successful. Paris learned, with as much satisfaction as if it had been a victory, the return of the first aerial messenger. The victory was real, but it was only against routine that it had been gained.

Louis Godard, the brother of Eugène, possessed a balloon which could carry a man and a child; he had also another, used for elevating fire-works, and which could support a child. Louis Godard, in his performances at the Paris Hippodrome, sometimes executed a somersault truly astonishing. He kept himself upright on a platform placed on the middle of a pole, to each extremity of which was fastened a balloon. The solution of the problem of the union of the two little balloons, the *Hirondelle* (Swallow) and the *Napoléon,* did not then offer any difficulty to so able a performer. The one globe was kept underneath the other by means of a pole of suitable length. Louis took his place in the car of the *Hirondelle,* and his passenger in that of the *Napoléon.* The group thus formed received the name of the *Etats-Unis.* Impelled by a light easterly breeze, the *Etats-Unis* disappeared in the direction of St. Germain.

Louis Godard received as a supplement to his ballast a number of packets of the *Officiel* newspaper, and of the principal journals published in Paris. Scattered in profusion all along the route, these sheets were as eagerly collected as if they had been celestial manna descending from the yet pure heavens. But this singular propaganda was not without danger to those who profited by it. One of the packets scattered by Louis fell while the balloon was passing over a convent at St. Germain. The Prussians, who watched with anxious curiosity the route followed by the balloon, perceived the fall. Immediately the neighbourhood was surrounded. Rigorous visits were made from house to house without losing a minute, but in vain. Furious at not being able to find anything, the leader condemned the town to a fine of 10,000 francs, under threat of pillage, and of sending the authorities to Germany.

The last irregular balloon was the *Céleste*, which I had given up to the service of the state. The ascent of the *Céleste* was signalised by the transmission of the first French post-cards, which, however, were not used to the extent they might have been had people been patriotic and shrewd enough to perceive their advantages. A project was also formed for sending letters and proclamations by means of fire balloons, as the Metz officers had succeeded in doing. Experiments were tried at the Grenelle gasworks, but the first attempts were unfortunate from the want of skill on the part of those entrusted with the expedition.

Private individuals conceived the idea of making use of balloons to escape from Paris. One, which was sent up by an unskilful hand, fell just outside Paris, between the French and the German lines; and it was only by lying flat among the reeds of the Courneuve Marsh that the passengers escaped the balls of the enemy. After this the governor wisely ordained that no balloon should quit Paris without a passport signed by himself.

CHAPTER XXXV.

THE CLIMAX OF THE AERIAL SERVICE.

It was the 7th of October, 1870, about two o'clock in the afternoon; a light wind blew from the south, and the sky was covered with beautiful clouds. Two balloons were being prepared in the Place St. Pierre, where an unwonted activity prevailed. Since morning numerous couriers had been going and returning in all directions. It was felt that an important event was about to happen. M. Gambetta, the youngest and most influential member of the Government, had resolved to quit Paris in a balloon. He was accompanied by his intimate friend, his *alter ego*, M. Spuller.

The balloon, the *Armand Barbès*, which bore the future Dictator and his fortunes, did not set out alone. It was accompanied by the *Georges Sand*, equipped by some American citizens. The latter, who might have procured a passport through their ambassador, preferred to accompany the Dictator of the young Republic.

Although the various successful attempts which had been made had produced great confidence in all classes of the population, yet it was with a universal sentiment of relief that people read next day in the

Officiel the decree which despatched M. Gambetta to the provinces, and the pigeon-message stating that the order had been executed, though not without danger. Owing to a wrong manœuvre, his balloon had come to the ground in a field which the Prussians had just quitted. If he had started a quarter of an hour earlier, the young Tribune would very likely have fallen into the hands of the Prussians, and been sent to join the vanquished Napoleon. Springing upwards at random, the balloon became clumsily entangled in the branches of a forest. The danger run by M. Gambetta should have opened people's eyes; on the contrary, however, it only closed them. The infatuation for balloons was pushed to the extreme. Some high personages, in their sudden enthusiasm, believed thenceforth in the infallibility of aeronauts.

In one of the balloons that fell into the hands of the enemy was found a letter of one of the members of the Government of the National Defence. This patriot opened his heart to a bosom friend, as if there had been no Bismarck to dread—an uninvited third party to the epistolary conversation. The imprudent missive was immediately published in the Prussian *Moniteur*, translated into all the foreign journals, and circulated throughout all the invested departments.

A model uniform was adopted for postal balloons, economical, comparatively substantial, and rather elegant. They had a capacity of about 72,000 cubic feet. Including those which were found in the Magazine at the time of the capitulation of Paris, between seventy and eighty were manufactured at a cost of about 160*l.* each. The number of letters carried having exceeded three millions, the postal receipts were increased by more than 36,000*l.*

One can easily believe that the wonderful spectacle of these ascents will never be forgotten. As few Parisians shared the simple security of the member of Government whose prose made such a stir, they often contrived to slip into the pocket of the aeronaut at parting a letter which would not be sacrificed. These men never refused to perform so light a service which brought consolation to many anxious hearts. One can imagine with what joy and pleasure loving mothers separated from their children, husbands deprived of their wives, sons and daughters far from their aged parents, would watch the balloon disappear in space. With what anxiety must they have inquired as to the direction and strength of the wind! For all was lost if the balloon, driven by an uncertain squall, wandered too long over the invested districts; if it should return upon its route; if a storm should send it out to sea, or, what was still worse, into the enemy's country. Who does not recall those signs of joy which were everywhere evident when the arrival of a pigeon was announced?

M. de Villemessant, the editor of the *Figaro,* conceived a scheme as happy as it was original. He started a journal without precedent, which he named the *Balloon Post.* That sheet, weighing about two pennyweights, contained a substantial and well-written *résumé* of all the interesting news of the week. It contained, besides, two blank pages—one for the address and the other for private news. Under the circumstances, it would be difficult to contrive anything more useful or ingenious. Numbers of the *Balloon Post*, which reached the most distant countries, are preserved as relics. Large sums have been given for copies, and in some cases they cannot be bought at any price.

CHAPTER XXXVI.

MICROSCOPIC PHOTOGRAPHS.

About the second week of October, private letters were received in Paris from Tours by means of pigeons. A clever photographer had devised a method of copying two or three hundred despatches on a square of paper which could be fastened under the wing of a pigeon. A powerful glass or a microscope was used to decipher the messages. But the inequalities of the coarse paper, as well as the writing, prevented the carrying of this industry to the point of perfection which was demanded by the exigencies of the terrible situation in which the country then was. M. Dagron succeeded in triumphing over the numberless difficulties which had hitherto arrested the most eminent photographers. He prepared a little pellicule of collodion so homogeneous that it could be magnified to any extent.

The reading of these microscopical messages was done at the Rue de Grenelle, where a microscope was established and lighted by means of the electric light. The apparatus was placed in the interior of a magic lantern, so that the characters were projected upon a white screen, and scribes placed at a short distance had nothing to do but copy.

The ancients would have raised a temple to celebrate so astonishing an accumulation of extraordinary inventions, almost all due to the French, and which came providentially to their aid when all the universe seemed to have abandoned them.

It was calculated that each pigeon could easily carry fifty thousand despatches, containing matter equal to thirty-six folio pages. These five thousand despatches were photographed on six pellicules of collodion, weighing in all about nine grains, a weight altogether insignificant for a carrier-pigeon. Without at all fatiguing the birds, the load might have been trebled, and a hundred and fifty thousand messages entrusted to them at once: the number of distinct despatches sent off during the whole of the siege of Paris. In order to be certain of the arrival of these messages, a system of repetition was employed; each of the messages was photographed, on an average, fifteen times, and entrusted to fifteen different pigeons. Thanks to that precaution, postal communications were never altogether interrupted; they would, indeed, have been carried on in an altogether satisfactory manner if the pigeons had not often entirely failed. In fact, the number of birds sent from Paris did not exceed two hundred and fifty, among which many, we may add, were only carrier-pigeons in name. A great many were sent off from the outside in unfavourable conditions, which rendered their return almost impossible.

These great and wonderful successes seem to have raised the jealousy of foreign officials. The London postal authorities openly discouraged the public who asked for information, and advised them not to use so uncertain a method of correspondence. What would these critics have said had they known that M. Dagron, having asked for an article that could not be procured at Bordeaux, received it next day by a balloon which had left Paris on the previous evening? He would have been served with less rapidity even by the express, if the railways had been working.

The Dagron expedition consisted of two balloons, the *Niepce* and the *Daguerre.* Both of them started from the Orleans Station at 10 A.M. of the same day, in a moderate wind that blew in the direction of the upper Seine. The wind appeared favourable, and there was no apprehension as to the result of the expedition. Some pigeons carried on board the *Niepce* returned some hours after to the dovecot. There was no need to decipher the despatches to see that a mishap had occurred. In fact, the paper found under the wings of the unfortunate birds had been fixed by an unskilful hand. A gamekeeper of M. de Rothschild informed the Government that the balloon, pierced by balls, had fallen into the hands of the enemy. He hastily sent off the news by some of the pigeons he had been able to take from the Prussians. Consternation immediately spread throughout the besieged city. It had been ascertained two days before that the *Galilée* had suffered a similar fate, and it was feared that M. Dagron, who was in the *Niepce,* had also perished. This was only half true, however, for the descent having taken place in a district invested by the enemy, it required prodigies of ability and devotion on the part both of the aeronauts and the people of the district to keep the precious cargo out of the hands of the Germans. It was only at the end of November that the Parisians were assured of M. Dagron's safety by the arrival of the first microscopical despatches on pellicules. But by that time sad measures had been adopted. The service of balloons never recovered from the first checks which it received; to a blind confidence had unfortunately succeeded an excessive timidity, not less sad and not less without foundation.

The agents of Prussia within the walls of Paris spread the report that the German Government had constructed a Krupp cannon, similar to a telescope, which could reach the French balloons in the midst of the air. This silly report produced an incredible sensation. All the aeronautical shipwrecks were attributed to this weapon—a weapon which was seriously described in scientific journals and believed in even some years after the siege of Paris.

A mistake of another kind—the unlimited confidence which was placed in the perspicacity of the official meteorologists—was scarcely less calamitous. We shall give, as an example, what happened to the *Jules Favre* balloon. Before setting out, the aeronaut was ordered to remain in the air a certain number of hours, determined by the rate of the wind as indicated by the anemometers. Faithfully obeying the orders which had been given him, the simpleminded aeronaut would not open the valve, and the balloon was seen to be making for mid-ocean. The passenger, perceiving that he was passing over land which was no other than Belle-Isle-en-Mer, compelled his conductor to disobey the meteorologist who had given an order observed with heroic stupidity. By a strange chance, the *Jules Favre* anchored close by the house of the brother of General Trochu.

Nearly the whole of the aerial service was performed by a few pigeons, which crossed the Prussian lines four times; one pretty little female carrier, with an intelligent expression and beautiful blue eyes, which accompanied Gambetta when he quitted Paris, performed the feat five times. The audacity of this female was very naturally explained by the fact that a pair of charming young ones awaited her return to the dovecot in Paris.

CHAPTER XXXVII.

HOW I LEFT PARIS IN A BALLOON.

THE capture of the *Galilée* and the catastrophe of the *Daguerre* had sown alarm in Paris. Ignorance of aeronautical matters was so complete, that the scientific commission on ballooning did not think of the simple remedy for such catastrophes. The poor aeronauts had only to sacrifice a bag of ballast to be able to sail far above the Uhlans, who followed them at full gallop. Nothing was more easy than to float without danger the national flag in sight of the invested population, to strengthen their courage, and to sow along the routes the proclamation of the Government.

In order to avoid catastrophes, the public security and military self-respect were sacrificed. The members of the scientific commission conceived the idea of sending off balloons at night. Our indignation knew no bounds when we learned that aeronauts were to flee the light of the sun and take refuge in darkness, like birds of the night; we took the part of preaching by example, of constructing a balloon and setting out in broad daylight.

M. Giffard had placed at our disposal the great captive of the Universal Exhibition of Paris. After much trouble we succeeded in dragging it to the

UHLANS PURSUING A BALLOON.

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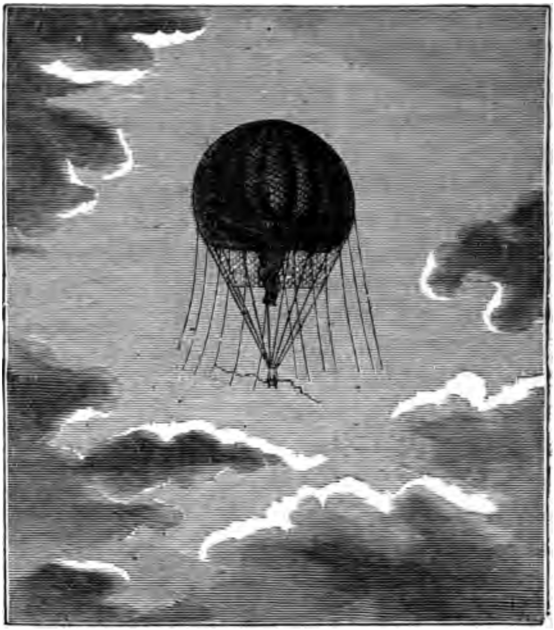
La Villette gasworks. A false manœuvre occurred during a violent wind; a whirlwind snatched the balloon from us and launched it in full view of the Prussian camp, a ridiculous wreck.

As soon as it was ascertained that the recovery of the old balloon was a clear impossibility, I busied myself with the building of a new one. I should have been dishonoured in my own eyes if, having so long advocated the use of balloons in time of war, I should not have ventured in them myself. I was not of a temper to imitate those peaceful aeronauts who, having executed hundreds upon hundreds of ascents in quiet times, were satisfied with the questionable profits of balloon building and selling at high prices. But the building of a balloon was not a small affair during the siege of Paris. It was exceedingly difficult to procure workmen, because almost every one of them was engaged in the Garde Nationale. It required much trouble to obtain from the proper military authorities a dispensation from training, working, and keeping guard. The public buildings large enough for varnishing a large balloon were occupied mostly by provisions or beds for wounded men. The only resource for aeronauts was to address the railway companies; the different railway stations having been gradually converted into the head-quarters for balloons going from Paris up to the moon. It is true we were not yet arrived at that point, but I was told repeatedly when a boy that, *il n'y a que le premier pas qui coûte*, and I beg the leave of the reader to extend the meaning of that saying to aeronautics. Varnishing, besides, is a long and tedious process, where it is requisite to perform the operation several times, and each operation cannot be effected so long as the previous varnishing is not perfectly dry. Besides, never in my life had I looked so carefully into the material, paying attention to each hole, ready to go into the balloon with a microscope in my hands. I reflected carefully upon the construction of the valve itself—that plague of every aeronaut. I tried in former times leather, gutta percha, india-rubber, wood, and ivory, in different shapes, without any great success.

During all this time passengers were urgent to depart, and everyone was delighted when I appointed a departure for Sunday morning, the 20th of November. Everything was ready on the Saturday evening, and the men had worked with the greatest activity during almost the whole night. One thing remained to be done—it was to send the balloon from the railway station to the gasworks, from which the ascent was to take place. The wagon was in readiness, as well as two lean horses, but the foreman had been hard-up, and in time of blockade what is to be done with money except to drink with it! The weather was admirably suited for my purpose, when I arrived in high spirits at the gasworks, after a rest of a few hours. But nobody had seen anything of the balloon, or of the two lean horses. The balloon was on its way as stated, but rather an odd and roundabout way. How could I ascend with my balloon running about in the streets? Passengers were furious, time was passing by, and what was worse, the wind was changing and beginning to blow stronger. It was full noontide when the balloon was duly placed under its net, ready for inflating. What was to be done? My aeronautical practice induced me to fear some crushing catastrophe, but I had given my word of honour that the departure should take place, weather permitting, and the weather did permit; at least, it was not quite forboding. I called a meeting of my passengers, and used my best powers of persuasion. "Gentlemen," I said, "I should not be justified in saying that we cannot leave, so we will leave if you think proper. However, if I had not given my word, I should not give it now, so I beg for a delay, which I think it would not be unreasonable in me to impose."

That speech of mine produced an effect quite contrary to the one I expected. Instead of granting the delay, passengers insisted upon immediate departure. They believed that I was speaking mere commonplace, and perhaps suspected that I was afraid to go, and that I should never ascend. I ordered the valve to be opened at once, and closed the pipe from the gasmeter to the balloon. *Egalité*, such was its name, was soon half-full, and began in less than three-quarters of an hour to show its bright colours and nice form. The sun was shining on the golden sphere, which the wind was gracefully oscillating. The net, constructed with light and strong ropes of the best description, was scarcely to be seen. *Egalité* appeared attached to the earth not by a mere mechanical contrivance, but by some work of wonder. Unfortunately such was not the case. *Egalité* had within its large sphere its worst enemy, that dreadful and dreary Prussian spy was the end of the gaspipe, which was of copper. I had not been mistaken, alas! in my sad apprehensions of some impending catastrophe; the wind was now blowing at a dangerous rate. I was looking on the clouds, which showed a direction inclining somewhere towards Prussian soil, when I heard people shouting. A large hole had been made by the



DESCENT OF THE EGALITÉ AT LOUVAIN.

copper end of the pipe in the graceful fabric. That hole was gaping like the mouth of a Polyphemus' cavern. It was too late to think of mending it, and of ascending afterwards before sunset. A stern necessity, in the shape of that diabolical hole, obliged me to stay. I gave proper directions to the workmen, and with my own hand I opened the valve of the balloon. Gas escaped in a moment, with a kind of whistling sound, which seemed to me almost a laugh, and the poor balloon fell heavily, ingloriously, on the canvas. On the following morning the weather was horrid, the wind blowing with a true Uhlan rage. Rain was also falling, and it was a heavy rain; the weather was cold and unpromising, but the passengers, heedlessly impatient, were more boisterous than the air.

When I saw their behaviour I approached and said, in an imperative tone, "I am the commander of the craft, and I pray you to leave the place and return to-morrow at the same hour, when we must leave if it please the wind or me." They left, but speaking and plotting together.

On the following morning I returned at the appointed time, but the wind had become worse, rain was heavier, and passengers arrived, bringing with them a solicitor. The solicitor was instructed to see that I did not leave the ground. When I saw the legal practitioner, I told him that he had better send his summons to the wind, and that I should rather advise him to fine Æolus before our courts of justice, but that I should not shorten my stay for an inquiry to-morrow; I said, moreover, "I will come again at the same time, and if the wind suits me, I will leave; and instead of my passengers, if they are not present on the spot, I will take sacks of ballast, which I think will be much better." On the following morning I came again; the wind had not abated, but, in some respects, the passengers had. They were ashamed of their ridiculous attempt to prosecute, and consented, without any reluctance, to return again.

When I arrived at 8 o'clock in the morning, the sky was covered with disconnected clouds, having a promising aspect. The wind was blowing gently indeed towards Belgium—that happy land of freedom and liberty, which Napoleon plotted shamefully to plunder. Lieutenant Bunelle had summoned a hundred *douaniers* and sailors belonging to the adjoining *secteur.* A good many naval officers were present besides, and a little after 10 o'clock I had the satisfaction of seeing two French admirals coming together, Admiral Montagnac and Admiral Chaillet, an intimate friend of my brother. As all had been prepared on the preceding morning, I had time enough to explain to my illustrious visitors everything connected with my expedition. Very few of my private friends were present except the people connected with my balloon experiments; among whom I may mention a captain of the Press Sharp-shooters and the Papa Barnivet, an old, short, white-haired gentleman, who for forty years had constructed balloon valves. That gentleman was very well off, owing to the balloon trade, and was very proud and satisfied, having invented and constructed my valve. He was telling everybody that it was the first improvement that had been tried since the beginning of the war, but it should not be the last, as he would soon send me a new valve a great deal better than that used by one of the first postal balloons!

This marvellous valve, so much praised beforehand by Papa Barnivet, gave me the power of regulating ascents and descents so nicely, that I should not break an egg's shell in landing if it were placed by accident under my car! I hoped and trusted that this *chef-d'œuvre* of Papa Barnivet was not destined to be carried away from Paris as the poor fellow was who conducted his aerial craft to the Norwegian shores; or, alas! even the more unfortunate sailor, Prince, who was, according to all probability, engulfed by the waves of the raging Atlantic.

There were very few gentlemen connected with the press, except M. Tarbé, junior, the then editor of the *Gaulois*, filling the post of his eldest brother. The elder Tarbé had escaped from Paris in disguise with Americans or Englishmen leaving Paris. He was attired, it appears, like a carrier, a porter, or a gentleman-in-waiting. I preferred, for my own part, to be disguised as a swallow, or even a carrier-pigeon. Was it not the proper time to remember the graceful Michelet's work, the motto of which is "*Des ailes, des ailes,*"—Wings, wings, and wings again?

When all was ready, I drew the rope, and the appendix opened. The valve-rope came down gently, but the safety-rope which was intended to tear the balloon, if drawn by a powerful wind, did not follow.

Aeronauts would suffer the worst of deaths if they cut their balloons in halves when floating in the air; the tearing rope therefore must be used only when the car is grating the earth, when the anchors are grappling with their whole penetrating powers, running through the soil like so many ploughshares. I had repeatedly urged upon my builder to attach this rope in its proper place, but I had not been obeyed. The preceding day I had looked over the balloon and caused it to be filled with common air in my own presence, and had ordered the missing rope to be attached; but if the rope was attached it was not ready for use. It had been tied up into a small bundle by some unknown hand. It would not come within the reach of my hand. The rational way was to open the valve and postpone the ascent, but that way was rather expensive and rather cowardly. I did not hesitate for more than half a second, and being satisfied with the lifting power, I gave the order to let go the craft. The order was complied with, with extraordinary precision, and we ascended gently, travelling towards the northern part of the city. An immense crowd had collected round the gasworks; the streets were paved with hats, and tremendous shouts answered our own cry: "Long live the Republic! down with German butchers!" It was like the voice of the earth coming to the heavens; our golden ball lifted itself towards Olympus' gates, loaded with human prayers. If perchance I were Jupiter, I should certainly pay a great deal of attention and care to the wishes and thoughts of two millions of inhabitants brought to me by a handful of aeronauts.

Now we are floating above the great seat of learning, whence so many sparks of genius spring out to brighten the whole earth. It was the proper place to think of Ianthe's pure soul carried away by Queen Mab in her surpassing palace of Fairy Land! My balloon was dragged by invisible horses, less material than the queen's winged microscopical carrier. But my senses are made of human clay, which keeps my soul deaf and blind. I don't hear the groanings of the fatherless, and I don't see the serpent which feeds on the tyrant's bosom. But I wonder at the marvels of surrounding clouds, tinged by the sun's rosy fingers. Spenser had seen nothing more delicate and harmonious when wording his most musical and delicate rhymes; neither has Turner invented more fierce combinations of sunbeams.

We soon arrived at the gates, and we saw desolated fields, disappearing one after another. I recognised different parts of this once happy land, where I have wandered during so many happy years. We twice crossed the Seine—that noble Seine!—in a place where German horses will never drink, and I could see distinctly where my old balloon had been taken by German hands. I was looking at that spot when the first shot was heard by my distracted ear. I laughed merrily, because the barometer showed more than 5000 feet, and I told my passengers: "This is the beginning of German music, which is played down below by a full German band. Herr von Bismarck reproached our dear Trochu for wasting his powder, when shelling the German works. I wonder if the German powder, even with the skill of Mein Herr Krupp, is better employed in shelling French aeronauts?"

THE BALLOON OF THE SAILOR, PRINCE, ABOVE THE OCEAN.

In less than two hours we reached Louvain, having journeyed at the rate of about eighty-eight miles per hour.

A few days after our successful journey, another nocturnal balloon went up on a moonless night, and in a violent wind. A brave sailor, named Prince, was the sole occupant of the car. On the morrow, at dawn of day, some fishers on the north coast of Scotland saw a globe disappear towards the west and sink in the great ocean. A poor mother and two sisters bewailed the loss of the unfortunate waif.

Accumulated disasters of this kind opened at last the eyes of the Administration, and it was decided that departures thenceforth should take place not earlier than a little before sunrise. Although this could not have the moral effect of a passage in broad daylight, still the method was not liable to the dangers of night ascent. It was thus that the astronomer Dr. Janssen, who had been commissioned to observe the eclipse of the sun in Algeria, was able to leave Paris with all the necessary instruments in his car.

CHAPTER XXXVIII.

THE LAST SONS OF ICARUS.

THE misadventures of the son of Dædalus have not prevented, it would appear, a certain number of fools from flying in his tracks. Simon, the magician, would have launched into the air before the Christians, confounded at his audacity; but St. Peter, who was present, put a sudden stop to the experiment of the impostor. A certain George of Trebizonde, having thrown himself from a tower in the amphitheatre at Constantinople in presence of the Emperor Comnenus, experienced the same fate as did Simon, the magician.

Jean Baptiste Dante, a mathematician of Perouse, who lived at the end of the thirteenth century, was scarcely less prudent. He attempted to fly during a fête given on the occasion of a marriage, but came off rather better than the other two, as he only broke his leg. Such also appears to have been the result of the experiment of the English Benedictine, Oliver of Malmesbury, who fell to the foot of a monument from which he had precipitated himself into space.

In 1678 a certain Besnier, a mechanician of Sablé, invented a flying machine which had the honour of figuring in the scientific journals of the day, but when he attempted to use it he was unable to quit the ground.

About the same time a mechanician, named Alluard, threw himself to the bottom of the terrace of St. Germain, Paris, but came so rudely into contact with the ground that he broke his leg. The advocates of mechanical flight maintain that the accident happened to this experimenter only after he had crossed the Seine in the direction of what is now the wood of Vésinet.

A canon, named Desforges, constructed in 1772 a flying machine, with the intention of leaping from the top of the tower of Guinette, at Étampes. The apparatus was sufficiently perfect to enable the worthy man to descend otherwise than by the staircase from that venerable mansion.

Shortly before the invention of balloons, Rétif de la Bretonne, a burlesque author of the latter part of the eighteenth century, wrote a ridiculous romance in which figured a family of flying men. Victor and Victorine, accoutred in the most ridiculous fashion, set out to discover the South Pole, where they encounter the most grotesque adventures. With a spirit inflamed by this nonsense, the Count de Bacqueville attempted to realise it. Leaping from a window in the Quai Voltaire, Paris, he fell on a washerwoman's barge anchored in the Seine. Joked by the journals of the time he did not again attempt his absurd experiment, though his apparatus was saved from wreck.

The invention of balloons got rid of the flying men for a time. We have seen that Blanchard, the ablest of the mechanicians who gave themselves up to the search for that philosopher's stone, renounced his chimeras in order to attempt to utilise a globe filled with gas as a means of traction.

But the desire of providing the public with a sensational spectacle, reawakened those ideas which might have been considered as for ever dead. Twenty-three years ago an acrobat named Leturr thought he would be able to direct parachutes by means of a very heavy and coarse mechanism, which he set in motion during the whole time that the apparatus was approaching the ground. He did not require to keep himself up, but only to overcome the lateral friction which opposed the movement of his apparatus. This experimenter gave several representations at the Paris Hippodrome. Twice he managed to descend after a fashion without serious injury. Thus he could maintain that he had obtained a genuine success. He set out for London with a sort of reputation, made, it is true, mainly by force of puffery. Leturr might even have gathered new laurels if a catastrophe, which it was impossible to foresee, had not interrupted the course of his experiments in the middle of June, 1854. Fixed to the bottom of a balloon he left Cremorne, when a violent wind began to blow. The aeronaut who directed the ascent was seized with fear. He did not dare to disencumber himself of a weight so considerable as that of Leturr and his mechanism. In spite of the cries of the unfortunate experimenter, who understood all the dangers of being dragged along the ground under such terrible conditions, he obstinately refused to cut the cord which attached Leturr to the balloon. When by being battered against the ground over a rough country the balloon came to a stop, Leturr was found motionless on his seat, where, before his departure, he was carefully tied. The unfortunate man had a large wound on his forehead, and was now all but a corpse.

Twenty years to a day after this catastrophe, another balloon started from Cremorne, carrying another flying machine and another experimenter much more rash than the preceding, for his programme was to unfasten himself without a parachute and to sustain himself without any other aid than his wings. This unfortunate man, whose name, De Groof, a Belgian, many of our readers may remember, had been at one time a shoemaker. He was the only true son of Icarus, for Leturr with his parachute was a heretic as much as the Austrian Deghen with his balloon. De Groof understood better than his predecessors the principles of aerial motion; but he was ill-rewarded for his audacity. He had constructed a spring which enabled him to unhook his machine without assistance. On arriving at a height of about 1600 feet he detached himself from the balloon, and endeavoured to move his wings with desperate energy, but to no purpose; he could not even preserve his equilibrium, and was dashed to the ground with his machine sideways in sight of a large number of people.

All the misadventures of flying men have not, however, been of a tragical kind. Not very long ago a Paris *sergent de ville* performed a grotesque experiment at La Villette gasworks, at which we may laugh without remorse. This man had devised a sort of strange machine, in the form of a bird, into the body of which he introduced himself. Each wing had a sort of pocket into which the operator introduced one of his hands. He suspended himself underneath the circle of a small balloon which was held captive, and struck the air with all the force of his two arms. Although he had practised on the ground, he was unable to maintain the equality of his movements. One of his wings got out of order, as also did the tail in which the body of the bird terminated, and which was set in motion by his feet. After some minutes of burlesque exhibition, the balloon descended and the experimenter unfastened, greatly out of breath. The aeronaut who had lent his apparatus took advantage of the gas to make an ascent; he disappeared among the clouds before the bird-man, whom he left on the earth, had time to deposit his counterfeit wings upon the grass.

CHAPTER XXXIX.

BALLOONS IN ENGLAND.

In 1854 the death of Leturr did not produce any sensation. The coroner proceeded with the inquest as in all similar cases; but the jury gave a verdict that there was no cause for action. It was different in the case of De Groof's death; the aeronaut who took him up was on the point of being prosecuted, and the Cremorne establishment of being closed.

The siege of Paris served greatly to create a strong taste for ballooning on the English side of the Channel. There is scarcely a public holiday or fête, in London at any rate, without a balloon being sent up. Two or three public gardens make aeronautics a "speciality," as the advertisements put it. It is no rare thing to see two or three balloons at a time floating over the English metropolis.

Unfortunately, since Mr. Glaisher terminated his series of ascents, no English man of science has attempted to imitate him; aerial voyages have ceased to have the least scientific pretext. The amateurs who accompany aeronauts scarcely ever take the trouble of recording the temperatures they meet with or the nature of the clouds they encounter. Mr. Coxwell alone, with a perseverance worthy of the greatest praise, continues to send occasional letters to the *Times*. Unfortunately, his health being delicate, he is compelled to employ assistants, who have neither his experience nor his knowledge. As a rule, the English journals treat balloon ascents with an indifference which is probably not altogether unmerited.

It is otherwise, however, with the English war department. By its permission, if not under its auspices, experiments in military ballooning are occasionally made at Woolwich, which have both a scientific and a practical interest. Experiments have, for example, been made at Woolwich with a round balloon to which were attached two screws; one of which, moving in a vertical plane, was intended to produce a movement of translation. The other screw, movable in a horizontal plane, was intended to produce an ascent when it was turned from right to left, and a descent when it was turned in the opposite direction. Satisfactory results are said to have been obtained. This idea of making balloons execute vertical movements is an exceedingly fertile one, and deserves to be worked out. In fact the employment of mechanical means would produce a complete revolution in aerostatics, and would give to ascents a degree of precision which has been sought after in vain by other means.

In the present state of things the only motive-power employed by the aeronaut to change his level, is weight. When he wishes to rise he renders the balloon lighter by throwing out ballast. The process is simple, but as we have no power to arrest this upward motion, the ascent will continue indefinitely as long as no gas escapes by the appendix in quantity sufficient to produce an equilibrium to the weight of ballast which has been thrown out On the other hand, if the aeronaut had at his disposal a motive power to change his level, he might limit himself to the use of gas and ballast only for the purpose of producing an equilibrium to the variations of weight caused by the solar heat or by a fall of snow or rain. With the exception of a slight movement produced by a force of impulsion which the resistance of the air rapidly annuls, his balloon would remain in the stratum of air to which he may have conducted it.

Strangers to these principles, which though indisputable are not generally admitted, experimenters have laid aside screws and occupied their attention with hot-air balloons. A Frenchman proposed to the French Ministry to employ captive montgolfieres in the army as movable observatories. This was a return to the evolutions of Pilâtre at the Réveillon Garden. The inventor of military montgolfieres proposed to give to the car the form of a carriage strong enough to carry all the material of the apparatus and the furnace intended to inflate it. As soon as the aeronauts set foot on the ground, they might then pack up the baggage and imitate the snail which carries on its back its fortune and its house. There was only one drawback to this little arrangement—the montgolfiere took fire on two or three different occasions. There remained nothing of these ambitious projects but a few handfuls of ashes, and the ascent was limited to that of an enormous volume of smoke.

CHAPER XL.

THE DURUOF INCIDENT.

After having been acquitted by the French Council of War, before whom he was brought up for the events of the Commune, Duruof resumed his calling of aeronaut. At the end of the month of July 1873, he had to make an ascent at Calais, a town where a taste for aerial experiments has always been strong. He intended to attempt on this occasion the passage of the Channel, to renew, in fact, the experiment in which Pilâtre lost his life, but which, if the wind be favourable, does not present any exceptional danger.

As, however, on this occasion the wind bore right out to the North Sea, the municipal authorities refused, not without reason, to authorise the departure, although the balloon, completely inflated, was held by its ropes in the middle of the Place d'Armes. Unfortunately, the Maire did not care to take upon himself the responsibility of the veto which he pronounced. The public, who had not been made aware of what had passed, imagined that Duruof refused to carry out his programme. Some melancholy individuals, such as are to be found in all great crowds, cast doubt upon the courage of the man who opened up the route of the air to the aeronauts of the siege of Paris. Duruof immediately ran to the Maire, got possession, by a little subterfuge, of the car which had been taken away, and set off with his wife, to put to shame those carpers. The night came down terribly dark and stormy, and the intrepid aeronaut disappeared over the sea.

A feeling of horror seized nearly all Europe when this act of heroic rashness became known. For three days the attention of all was earnestly fixed on that corner of the ocean; everyone was anxious to know if Duruof and his heroic spouse had been saved by a miracle, which none, however, expected. At last a telegram from Wisby allayed the universal anxiety. The two shipwrecked balloonists had been saved by the vessel of an English fisherman off the Skager Rack. The conduct of all connected with this almost tragical incident was quite heroic; the simplicity of the woman, who believed she was going on a pleasure-trip; the coolness and energy of the husband, who, in a terrible situation in which the most daring might have been paralysed, retained completely his presence of mind.

It is said that a German vessel, which sighted the unfortunate couple, made all haste to get away from them, in the same way as the Dutchmen treated General Money in 1784. But the French colours, which the *Tricolore* bore prominently at her equator, were seen from the vessel of the English fisherman. Immediately the captain of the *Grand Charge,* as it was called, set all sail, at the risk of being himself capsized. He bore down upon the balloon in such a manner as to intercept it in its onward course. When he succeeded he launched his boat, and jumped into it with his mate. Then occurred a scene to which the brush of the most skilful artist could scarcely do justice. The brave English sailors seized hold of the end of the rope, fixing themselves to the balloon which dragged them along at a furious rate. Duruof threw them his wife, whom they luckily caught hold of. At the same time he himself sprang into the boat, into which he fell exhausted, while the balloon disappeared in space.

The reception of Duruof and his wife in England, was, as might be expected, enthusiastic. The English aeronauts welcomed Duruof as a brother, and Mr. Coxwell lent him a balloon with which he made an ascent from the Crystal Palace in presence of more than twelve thousand Londoners. We took part in that aeronautical fête, which we shall ever remember. Never shall we forget the spectacle of the great metropolis shining through the clouds which enveloped one-half of it. We never saw anything more splendid from an aerial vantage-ground, except, perhaps, Paris armed in the midst of the lines of her besiegers.

The inhabitants of Calais made a magnificent reparation for the fault of a few croakers by collecting a handsome subscription. Duruof made use of the proceeds to construct a balloon, to which he gave the name of the generous town.

The sensation produced by the Duruof incident was of service to all our comrades of the siege of

DURUOF AND HIS WIFE IN THE GERMAN OCEAN.

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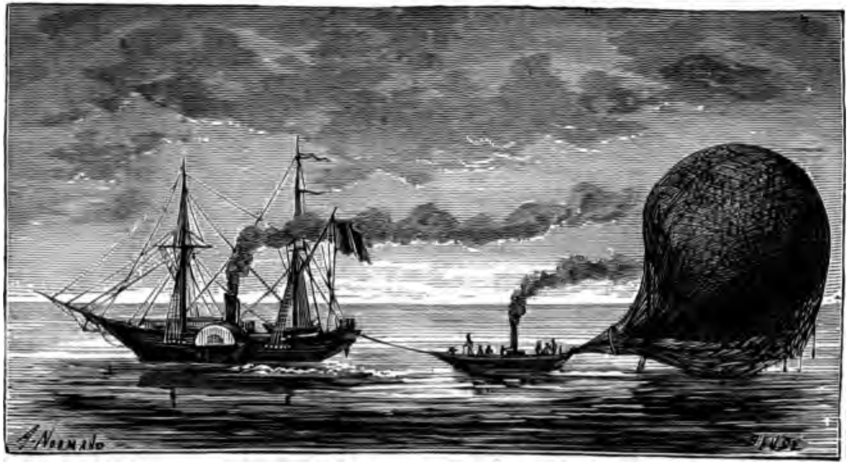
Paris. Animated by a laudable sentiment, the government of M. Thiers resolved to accord honorary rewards to the aeronauts who had forced the Prussian blockade. But as it was thought all had equally well served their country, it was decided that the crosses and medals should be distributed as a sort of mark of national consolation only to those who had suffered most in consequence of their devotion. The decree stated, in the enumeration of services rendered, that one of the recipients had been wounded, that another had been taken prisoner, that a third had descended in a distant region after having crossed the sea, &c. These selections were made, it must be admitted, with the most delicate consideration for the susceptibilities of all who were omitted. But the Duruof incident gave rise to some retrospective recrimination on the part of the public, who could not understand how the man who opened up the aerial highway should be forgotten. These considerations had some weight with the Municipal Council of Paris, who struck a commemorative medal, of which each aeronaut received a copy. This may be regarded as the epilogue of the Duruof incident, for had it not been for that remarkable and memorable rescue, the balloons of the siege would have been forgotten.

We may as well refer here to a more recent ascent of Duruof, in which, like the one just described, he made a watery descent, attended, however, with infinitely less danger. It was on August 21, 1876, that Duruof made an ascent from Cherbourg, in presence of an immense crowd, in the *Ville de Calais*, a balloon of 53,000 cubic feet capacity, constructed by the money collected in Calais after the accident in the German Ocean. It was a quarter to five P.M., and the wind bore north-east. The balloon soon made for the open sea, watched, we may be sure, with intense interest by the thousands of spectators. However, at Duruof's request, four steam-sloops and a steam-tug were cruising about in the offing. M. Duruof tried to find a counter current which would drive his balloon towards the land. But, after trying in vain to a height of nearly 14,000 feet, he renounced his design, and resolved to descend a second time in the open sea. In fact, the balloon was specially rigged for such a manœuvre, and the drifting would not be accompanied by the same dangers as in the North Sea descent. The car of the *Ville de Calais* carried cork floats, and a friction cone, shaped somewhat like a large extinguisher, invented by Green for trailing through the water at the end of the guide-rope on the occasion of the famous *Nassau* journey.

At ten minutes to seven Duruof let out the guide-rope, which diminished the speed of the balloon; but seeing that the steamer which followed could not come up with him, he threw the cone into the sea. As soon as the cone caught the water, Duruof threw over eleven bags of ballast, weighing 44 lbs.; but the effect was instantaneous, the balloon's progress was all but stopped. The crew of one of the sloops seized hold of the ropes and drew the balloon to the stern, the car was cleverly fixed to the helm, and the tug took them in tow.



THE "VILLE DE CALAIS" TUGGED INTO CHERBOURG HARBOUR.

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This success made Duruof ambitious to try another ascent. His plan was to take the balloon already inflated to Cherbourg, and to attempt next day a new excursion, starting this time from the roads. But before he got the balloon safe in harbour the sea became rough, and the tossing of the sloop, combined with the action of the wind, first made a great rent in the materials, and then sent it adrift. On being again caught it was found to be in ribbons.

CHAPTER XLI.

THE "ZENITH" TRAGEDY.

THE French Society of Aerial Navigation resolved, in 1874, to organise an ascent with the balloon *Etoile du Nord.* Two journeys were made. The second, on March 22, was intended specially to test the restorative action of oxygen breathed in place of ordinary air in a rarefied atmosphere. I have had occasion to criticise the results thus obtained elsewhere, and they seemed to me by no means favourable; for one thing, the experiments were very imperfectly conducted. The aeronauts of 1874 only reached an altitude often attained without any inconvenience being felt. Yet the account presented by them to the Paris Academy proves that they experienced serious derangement of the system, which their gaseous cordial had little effect in dispelling.

It was resolved, however, in 1875, to have another expedition under analogous conditions. There are certain extremely systematic minds that have an unhappy tendency to believe that in physiological experiments we may substitute for natural conditions certain artificial preparations or operations made upon the subjects. It was in obedience to this disastrous idea that the future aeronauts of the *Zenith* submitted to experiments made under a pneumatic bell, for the purpose of accustoming themselves to live in rarefied air. The "bell ascent" having given satisfactory results, it was believed that no obstacle could arrest the intrepid men who set out to repeat it in infinite space.

The *Zenith* set out from the La Villette gasworks, in Paris, in April 1875, on a day when the sky was cloudless, and when the cold dry polar current prevailed in the upper regions of the air. There were three persons in the car—M. Sivel, captain of the balloon, M. Crocé-Spinelli, and M. Gaston Tissandier. The last-mentioned was to carry out a particular system of analysis of the dust in the air with an aspirator containing a large reservoir filled with petroleum oil. This heavy apparatus was so arranged that the cords which fastened it to the car could be easily cut. The bags of ballast had been rigged outside the car in such a manner that by cutting a cord they could be emptied instantaneously.

The ascent took place gradually in a slight E.N.E. wind, the sky being blue but vaporous. The rate of ascent was calculated to be nine feet per second, but diminished gradually. Shortly after one o'clock the altitude obtained was 22,800, and the passengers were quite well, although feeling weak. The inhalation of oxygen produced good restorative effects when tried. Then a consultation took place, and the *Zenith* being in equilibrium, a quantity of ballast was thrown overboard. M. Tissandier then fainted, and was ignorant of what was felt by his friends.

At eighteen minutes past two he was awakened by

M. Crocé-Spinelli warning him to throw over ballast, as the balloon was fast descending. He obeyed mechanically, and at the same time Crocé-Spinelli threw overboard the aspirator, weighing eighty pounds. Tissandier then wrote in his book a few disconnected words, and again fell asleep for about an hour. When he awoke the balloon was descending at a terrific rate; no more ballast was left to be thrown away, and his two friends were suffocated. Their faces had turned black, and the blood was flowing from their mouths and noses. They were evidently dead. It was a terrible situation.

The only resource was to cut the grapnel-rope a little before the instant when the car should strike the ground, which Tissandier did with astonishing coolness. The wind had increased in strength, and Tissandier was obliged to tear open the balloon in order to stop it. It was caught on a hedge in a commune of Indre, called Ciron, 190 miles S.S.W. from Paris. Tissandier was but slightly hurt; the other two were dead.

The tragic fate of Sivel and Spinelli is perhaps to be ascribed to the fatal resolution of accomplishing at any price a height of 24,000 feet, but mainly, no doubt, to the throwing out of the aspirator, which was discovered afterwards unbroken, as it had been provided with a parachute. It was even stated that the barometer readings showed that a distance of 8 miles had been reached.

Many theories have been proposed to explain how one of the experimenters escaped the terrible effects of the depression, which he had been the first to feel,

DESCENT OF THE "ZENITH."

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since he was the first who lost the use of his senses. The favourable result of ascents which, notwithstanding a slight passing faintness, enabled Mr. Glaisher to rise to a greater height and to return in sound health, seems to prove that the rarity of the air, even aggravated by the giddy velocity of the ascent, was not sufficient by itself to produce the catastrophe. These causes must have been aided by some deleterious agent. The numerous accidents which we have had to tell of, and which have been produced by the gas suffocating and paralysing the aeronaut, suggest a very natural explanation. The unfortunate victims were no doubt asphyxiated, like so many of our *confrères*, by carburetted hydrogen, the services of which aeronauts cannot accept without risk. May not the petroleum, moreover, that filled the aspirator have added its deleterious fumes to those of the gas in the balloon? This is another grave question, for it appears that they emptied it before precipitating it to the earth, where it fell, like the carriage of Gay-Lussac, near a shepherdess who was watching her sheep.

M. Gaston Tissandier, who had passed through experiences worthy of the pencil of Dante, found upon the earth such hospitality as Theocritus has described in his Idylls. Having escaped by a miracle, considering his not over-robust constitution, the dangers of the air, he fell in the midst of a verdant meadow, where terrestrial nature displayed the fulness of her richest productions. He was treated with the greatest kindness and enthusiasm by the patriotic people of Blanc.

The fate of Crocé and Sivel is fraught with many lessons for aeronauts. No good purpose is served by allowing devotion to be pushed to the extreme, to the neglect of the most elementary rules of personal safety. It ought not to be forgotten that if the two aeronauts are dead, it is because they carried out with marvellous rigour the charge they received before quitting the earth. The sole survivor of the catastrophe has explained this enthusiasm by the vertigo of high regions, the voice which says, "Excelsior, excelsior, plunge into the dark blue of that gaping gulf!"

Sivel and Crocé are justly regarded as two soldiers killed on the field of battle, as was eloquently said at their crowded funeral in Père-la-Chaise, where quite recently a beautiful monument has been erected to their memory. The glory of these martyrs of science will only be complete if their trespass serves to prevent the return of similar catastrophes; if we learn better to contend with the extreme difficulties which they encountered. Their cruel fate shows that aerial enterprise bristles with dangers, that it is necessary to multiply precautions as is done in an expedition for the conquest of the North Pole, in order to leave to Death no opening by which he may seize his prey.

We cannot too much insist on this capital truth, the source of all progress in the air, as upon the land and the sea. The important, the indispensable thing is not to make long, dangerous, extraordinary expeditions, but excursions every part of which is marked by the most careful observations.

CHAPTER XLII.

HOLIDAY ASCENTS.

When an astronomer is anxious to observe the stars with an instrument of exceptional power, he does not take it easy, nor choose his times of work. Every night, especially in the middle of winter, in spite of the most rigorous cold, it is indispensable that he be at his post in order to take advantage of a space of clearness. The aeronaut who proposes to make an ascent for a determined purpose should proceed in exactly the same way; but what aerial voyager can flatter himself with having at his disposal night and day a balloon ready for inflation?

We have learned to our cost that the directors of great observatories will never make up their minds to recommend these experiments, although balloons have proved themselves capable of being utilised for observations of unusual interest. But how are we to find the means of sending them up at appropriate times?

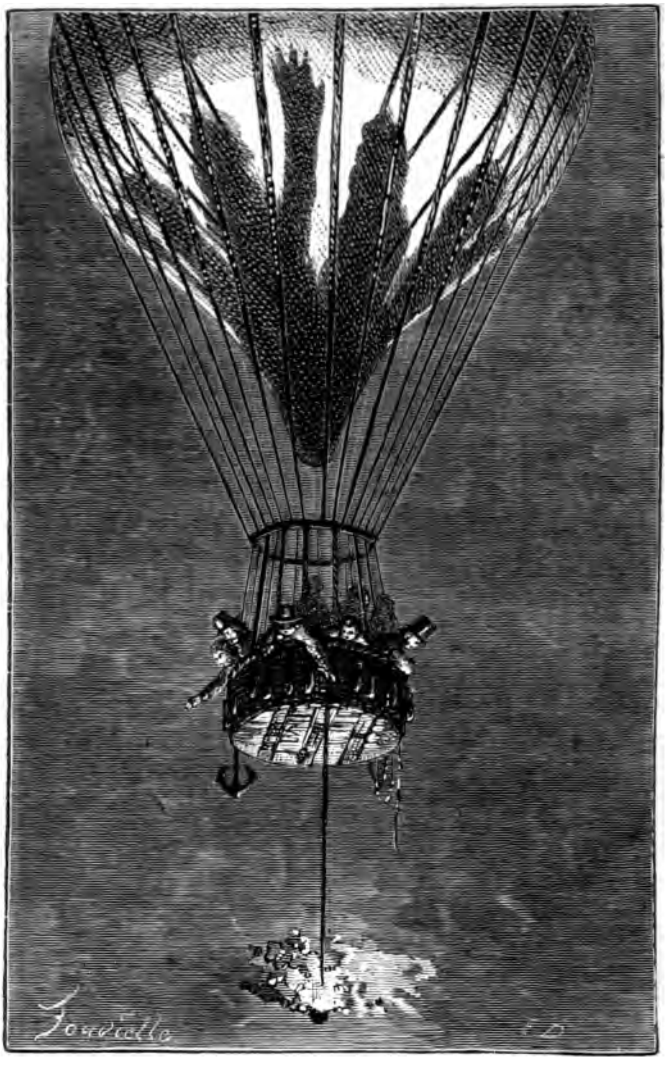
Happily, the number of scientific results to be gleaned in the heavens is so great, that even very mediocre observers could not but find important results, were they to make a sufficient number of ascents. We would therefore say to those who attempt to sound the wide unknown above: "Get into your balloon, look quietly around you, and soon you will know more about the air than all the wise men who remain on earth."

But how to follow our counsel? The most simple plan is to take advantage of the ascents by competent balloonists at public fêtes. It has been in this way, indeed, that many of the results we have referred to have been acquired. We can refer to our own experience in support of the advice we have given, and which we emphatically repeat.

Aerial operations require a multitude of adjuncts, of which it is difficult to conceive without having had actual experience of the obstacles which are apt to daunt one at the very outset. Happily, a reward for all exertion is to be found in the air. Not only do we enjoy in peace a beautiful spectacle, but we can often snatch from nature secrets of vast importance, if we take note of all the details of the business of an aeronaut, if we have shared in all the emotions of the men of the air, and if, without pretending to rival them in bravery and dexterity, we have aided them in their combat against the wind and the people.

We have written the preceding pages in the hope that our example may be followed, and that men of science and leisure will interest themselves in aerial navigation, as the most useful and most agreeable amusement imaginable, as a splendid exercise, not only for the body, but also for the spirit.

The nocturnal ascent which we represent in our illustration was directed by Eugène Godard on



NIGHT ASCENT OF EUGÈNE GODARD AT RHEIMS.

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August 2, 1875, with his balloon, the *Univers*, of 10,000 cubic feet. We left Rheims at ten o'clock in the evening, and we descended at sunrise near to Moret, at the entrance to the forest of Fontainebleau. During the night we observed a great number of shooting stars, at a period when none had been noticed from the earth. Probably we saw the vanguard of that shower which appeared a week later, and which was remarkable as well for its extreme abundance as for its duration.

But this was not the only result of this expedition. The echoes produced on the surface of the earth were so numerous, when not passing over a forest, that we asked ourselves whether it were not a practical method to ascertain the distance of the ground and even to discover its nature.

The illumination produced by the magnificent Bengal light which we trailed through the air was magnificently effective. But it was not a vain and futile decoration, for by its aid we could see terrestrial objects with great distinctness.

At the beginning of the month of September I took my seat in the car of the balloon *Saint Cyprien*, directed by M. Jules Godard, who performed his trapeze feats underneath on a frame carrying a dozen firework bombs. These exploded one after the other, at intervals regulated by the length of a match lighted before our departure, and calculated to cause them to explode successively.

This experiment might very well serve to determine the rate of sound, for the bombs made a terrific noise. They were heard on earth, and gave rise to echoes which reached the balloon. It trembled each time the sonorous wave reached it as though it were shivering.

A still shorter ascent, made two months later with the same aeronaut, brought out the extraordinary regularity with which every higher air-current is modified on approaching the earth, owing to the unevenness of the surface, which tends to slacken the speed of the wind. The *Davy*, as the balloon was named, had risen from the old Circus in the Place Eylau, with a feeble wind, which blew towards the west; as it rose, it met currents whose direction became more and more northerly. At 2300 feet above the level of the ground the aerial strata had already a north-westerly direction. At 4600 feet they had turned other 45 degrees in the same direction, and were driven by a real south wind, which reigned with a veritable vigour, and seemed to possess a tolerable thickness. A few hours later, this southerly current had disappeared and had given place to a north wind, for the night was cold, clear, and beautiful.

For more than ten hours it would have been possible to reach any point situated between the north and west of the Circus, without further trouble than to choose the suitable current below 4500 feet. It is probable that by ascending to 6500 feet we should have been carried towards the south.

To explore the atmosphere it is not necessary to have recourse to floating balloons; far less expensive experiments will suffice. By throwing little fore-runner balloons into the air, all aeronauts calculate with a precision often incredible the speed and the direction of the winds. Quite recently, in Paris, similar small balloons have been made use of to ascertain not only the direction of the various currents of air, but the height of clouds and other interesting points.

CHAPTER XLIII.

AERONAUTICAL INCIDENTS IN AMERICA.

The facility with which American journals accept the most extraordinary stories, and the vague and contradictory manner with which they report the most interesting aeronautical facts, are not calculated to give us a high opinion of their aerial knowledge. But the American journals approve of the interest which aeronautical operations excite.

The *Daily Graphic*, an illustrated paper of New York, furnished funds to a certain Professor Wyse, who proposed to cross the Atlantic and reach Europe in a balloon. This is a gigantic project, which has occupied the minds of American aeronauts for more than thirty years; but at the last moment Wyse proved himself more prudent than might have been supposed, and desisted.

Nothing evidently prevents this voyage from being made in two or three days, if a tempest can be found at a given point. But as the venerable Professor Henry of Washington remarked, aeronauts who wish to attempt such extraordinary experiments, ought to commence by making long ascents above the earth where forced interruption in the voyage is not a misfortune without remedy. It is not that there is no want of space in the New World for aeronauts who desire to distinguish themselves. An American aeronaut, having been caught a few years ago by a north-east wind, was forced to descend in the forests of Northern Canada. He was able to regain the United States only after an eight-days' march in a country covered with forests, where nobody had ever penetrated, and where he only found a few roots to satisfy his hunger.

The wind, which has more than once protected aeronauts, prevented one of the companions of Professor Wyse from making the fearful attempt on his own account. This aeronaut, who called himself Captain Donaldson, having attempted an inflation, perceived a rent in his balloon, and all the gas which he had uselessly accumulated during several hours evaporated in the air in an instant. With the remains of the globe thus ripped open, Donaldson constructed himself a large balloon, which he used for a series of ascents with journalists and amateurs, both at Philadelphia and at Chicago.

Balloons appear to be becoming more and more popular each year on the other side of the Atlantic; the celebrated Barnum could not fail to take them in hand. After having, it appears, made a voyage to Europe to inform himself of the state of aerial navigation, he placed at the disposal of Donaldson all the money necessary for a proper aerial equipment. But these attempts commenced unfortunately. Donaldson, who had made an ascent at Philadelphia, sacrificed his balloon in order to escape from the redoubtable ocean over which he appeared to be formerly so anxious to sail.

Fearing he might be unable to stop on the shores of New Jersey, where he was in full sail, he imitated the manœuvre of one of the siege aeronauts and cut the cords of his balloon. The globe fled into the Atlantic, and, we need scarcely add, nobody has heard of it since.

At the commencement of the month of August 1875, Captain Donaldson made an ascent at Chicago. The wind was very violent, and the inflation would have been impossible if Donaldson had not caused a row of masts to be erected, sustaining immense sheets, which served as a barrier to the impetuous course of the storm. Two journalists entered the car, although the wind was blowing a tempest. A sudden squall having thrown the balloon violently to the ground, one of the two passengers, of German origin, profited by the providential shock to throw himself on the earth, abandoning his two companions, whose aeronautical equilibrium was thus upset. The balloon disappeared like an arrow in the direction of Lake Michigan, upon the south shore of which Chicago is built. All the spectators returned sorrowfully home, fearing that a catastrophe was at hand.

A few hours later the captain of a small Swedish sloop, who was navigating the lake, saw a balloon approaching the surface, and made all sail to the rescue. The wind blew with such fury that the *Little Guide*, such was the name of the courageous little ship, was soon close to the car, which the skipper was about to lay hold of when the globe again flew up and disappeared in the clouds. The sailors, stunned by a velocity which seemed superhuman, asked themselves whether they had not been the dupes of a hallucination, if they were not pursued by the shadow of a cloud thrown by the moon on the surface of the waves. On arriving at Chicago on the following morning they learned the details of the ascent. No doubt was longer possible. Two more unfortunates had been sacrificed by their own rashness. About three weeks after the remains of the victims were cast ashore by the waves.

It was necessary, in order to convince her of the catastrophe, to show the body of Donaldson to his intended bride, who, like Pilâtre's, was present at the funereal departure of him whom she loved. Till she saw the body she refused to believe in his fate. "Donaldson must return," she said; "he cannot die, as I am to make my first ascent with him."

Seeing that the balloon, exhausted by the great bound at starting, could not sustain them, the unfortunate men had thrown out all their ballast.

The chimeras Donaldson had so long followed out were not to die with him. A German, named Schroder, took it into his head to build a directable balloon at Baltimore, intended to cross the Atlantic. He carried his audacity so far as to ask the Post-Master-General of the United States to make a contract for the transport of despatches. The latter having disdained to reply, Mr. Schroder furiously attacked him in the papers. Happily for this maniac, a storm at the beginning of the year broke over his horrible machine and tore it into rags, so that the experiment could not be made.

CHAPTER XLIV.

THE CATASTROPHE OF THE "UNIVERS."

The success of the ascents of M. Eugène Godard in Belgium were such that this able aeronaut wished to make a private ascent in Paris in honour of his passengers. But not being able to carry out this project, M. Godard placed his beautiful balloon, the *Univers*, at the disposal of Colonel Laussedat, president of the ballooning committee.

In consequence of a number of mishaps beyond the control of the aeronaut, the material of the balloon remained at the gasworks for a number of days during frightfully cold weather. Frozen to the core, though M. Eugène Godard had taken the precaution to cover it with an impermeable awning, the net shrunk in an astonishing manner. It had become so narrow that the normal distance between the car and the appendix was diminished by more than 4½ feet. The regular expansion of the *Univers* had thus become an impossibility. The stuff, which had not shrunk, but whose force of resistance had been diminished by the cold, was not equally sustained by the meshes in all its parts.

At the moment of departure, on December 8, 1875, a shower of hail fell on the balloon, which, accumulating on its upper part, complicated the position. Grains of hail, as well as flakes of snow, possess the property of clinging together under pressure, or at the commencement of a thaw. It is thus that the snowballs are formed with which boys amuse themselves, and the compact ice found in glaciers.

The icicles thus formed stick as well to the stuff as to the net. They form a material obstacle to the play of the meshes, which separate one from the other as soon as the balloon expands, but which could not now do so without acting injuriously on the stuff to which they are soldered. The stuff, whose power of resistance is diminished by the cold, opens, and the gas escapes in quantity by a rent, which rapidly extends.

The brave French officers who formed part of the expedition stretched out their maps with as much coolness as if they were seated at a table of the war department. Quite in his element, each one had his eye at the telescope or his pencil in hand.

Alas! before the studious observers had time to guess the nature of the danger that threatened them, a fearful shock, as the car dashes against the ground, makes their bones crack. The fall was so giddy that Eugène Godard required all his presence of mind to think of throwing out his ballast; but in the air an experienced aeronaut is never taken unawares. The passengers could only obey him in an imperfect manner. Before they understood the order it was too late to execute it. Eugène Godard threw the sand out with such fury that he received a shock whilst in an awkward position. He fainted, and when by an effort he recovered, the bone of the knee was found piercing the flesh. He had a broken leg. The balloon, which had been floating scarcely three-quarters of an hour, had not risen higher than 1300 feet. It floated as close as possible to the earth without entering the zone where bullets and balls can easily take effect.

The aerial accident took place in the commune of Montreuil, close to Vincennes.

The inhabitants, who heard the sacks falling with a tremendous noise, imagined that the balloon was throwing out shells or bombs, and they fled in all directions. It was only when they saw the balloon lying on the ground that they understood that a great misfortune had happened. Then they made all haste to succour the unfortunate aeronauts. The passengers who had had the presence of mind to cling to the rigging (which an aerial traveller should never forget to do) left the car, while the others remained to be tossed about pell-mell. Making an heroic effort, M. Godard raised himself up, and although his broken knee-cap pierced the flesh, he directed the rescue with astonishing coolness. Never has aerial misfortune been more rich in precious lessons.

We give an illustration representing the catastrophe and showing the gravity of the consequences of a hurried start. It shows the sad fate of passengers ignorant of the nature of the dangers they expose themselves to with such honourable confidence, without the slightest idea of the manœuvres they may be called on to assist in. Our sketch will show how

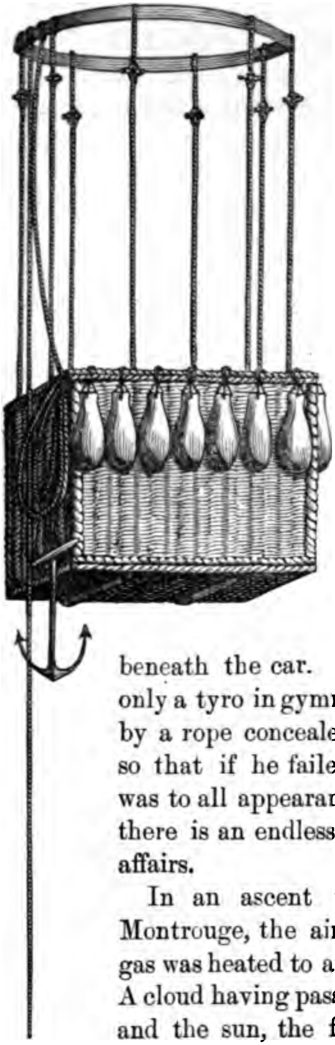
Page 293. CATASTROPHE OF THE "UNIVERS."

it was possible for the car to knock against a wall as it did, and rebound to one side, whilst the balloon fell to the other—that is, in the direction diametrically opposite. This strange separation of the valve and the car produced totally unforeseen effects. Caught under the stuff, the cord was stretched so tight that the springs moved automatically. One of the lids having assumed a perpendicular position on the plane of the seat where it rested, the valve refused to open.

M. Henry Giffard made an official examination of the balloon at the Hôtel des Invalides, to which the torn balloon had been taken. He examined it with care, and soon discovered the cause of the accident; it is from his report that we have taken the account given above.

We would call attention (see Fig., p. 294) to the peculiar manner in which we weighted the car of the balloon *Egalité*, from which we had the honour of flying the French flag in broad daylight, when the state balloons sought the darkness in order to hide themselves from the Prussian balls. In fact, if our method had been followed in the *Univers*, the throwing out of ballast would have been wonderfully facilitated. Godard would likewise have succeeded in saving his passengers if the choice of his helps had been left to him, if the officers, whatever their rank, had been told that they owed obedience to the aeronaut, should necessity demand it, and that he was the only master on board.

Another balloon tragedy caused a sensation in the autumn of 1876. M. Triquet, a cabinet-maker, had



turned aeronaut, and was in the habit of making ascents at the fairs round about Paris. He had quickly reached a certain degree of cleverness in his risky profession. But, as we say in French, *l'appétit vient en mangeant.* Desirous to increase the attractions, M. Triquet attempted to imitate Jules Godard, or at least caused his son to do so. He ascended with the young man, performing exercises on a trapeze suspended beneath the car. As young Triquet was only a tyro in gymnastics, he was attached by a rope concealed from the on-lookers, so that if he failed to grasp the bar he was to all appearance safe. Unfortunately there is an endless complication in aerial affairs.

In an ascent which took place at Montrouge, the air was so warm that the gas was heated to an extraordinary degree. A cloud having passed between the balloon and the sun, the frame was precipitated with uncontrollable force. Poor Triquet had not ballast enough to resist the condensing action of shade. His son had neither time nor coolness enough to resume his seat within the car; and as the wind was blowing with tremendous force, and the ground precipitous and covered with large stones, the son was crushed to death.

CHAPTER XLV.

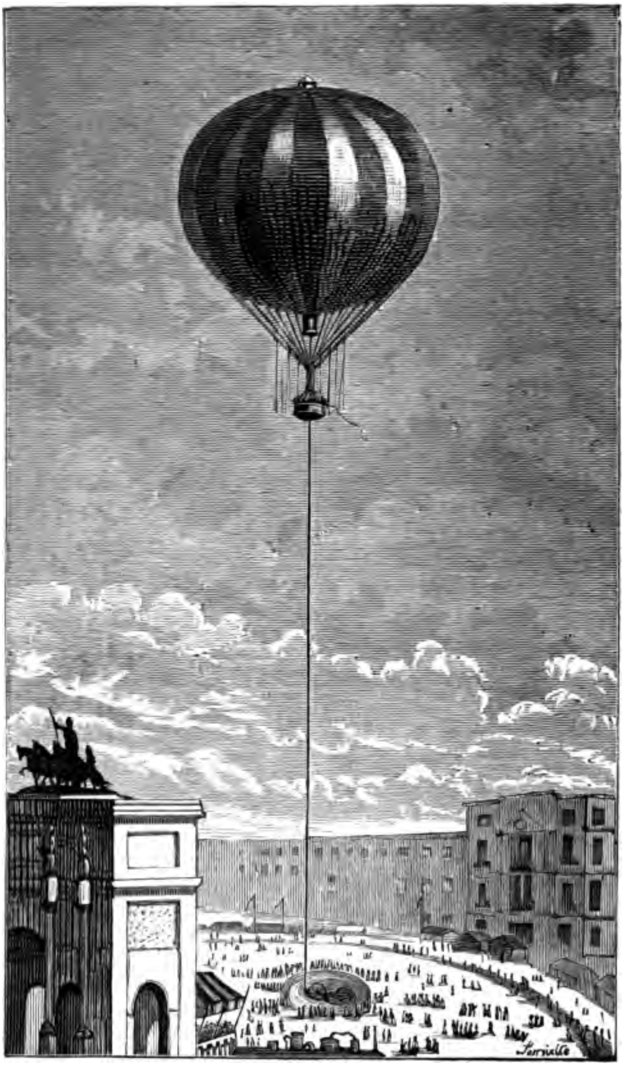
ANOTHER IMMENSE CAPTIVE BALLOON.

THE approach of the Paris International Exhibition of 1878 has determined M. Giffard to build a new captive balloon, which will be admirably equipped for a number of interesting experiments, and the execution of unprecedented ascents after having served its purpose at the Exhibition.

It was proposed at first to have it fitted up in the Champ de Mars, and M. Krantz, the general commissioner of the Exhibition, was instructed as to it; but it required such a space that it was impossible to grant this location. M. Giffard then asked to be allowed to place his monster balloon in the court of the Tuileries. Permission was readily granted by M. Caillaux, the French minister of public works, and M. Giffard received the notification of the ministerial decision on the 14th of August.

The height to which the balloon will reach from that central spot will be upwards of 1500 feet; but it is supposed that the cable will stretch, owing to the tension, and an additional distance of 150 feet will be gradually obtained.

The cubic capacity of the globe will be 777,000 cubic feet, with an elevating power of about 24 tons.



GIFFARD'S CAPTIVE BALLOON FOR THE PARIS EXHIBITION OF 1878.

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But as the canvas will undergo a certain tension, since the balloon will be closed by an inferior valve as well as a superior one, it is supposed that the capacity will be gradually enlarged to the extent of 50,000 additional cubic feet.

A register will be kept of all meteorological observations, and the captive balloon will be kept in constant communication with the International meteorological service. Free balloons will be sent up hourly, carrying postal cards with a request to the finder to send them back with an account of the circumstances under which they are found. A booking-office will be open for aerial pleasure-trips under the guidance of experienced aeronauts. On certain nights illuminations will be organised on board the car, where smoking will be allowed, as every precaution will be taken against the possibility of fire.

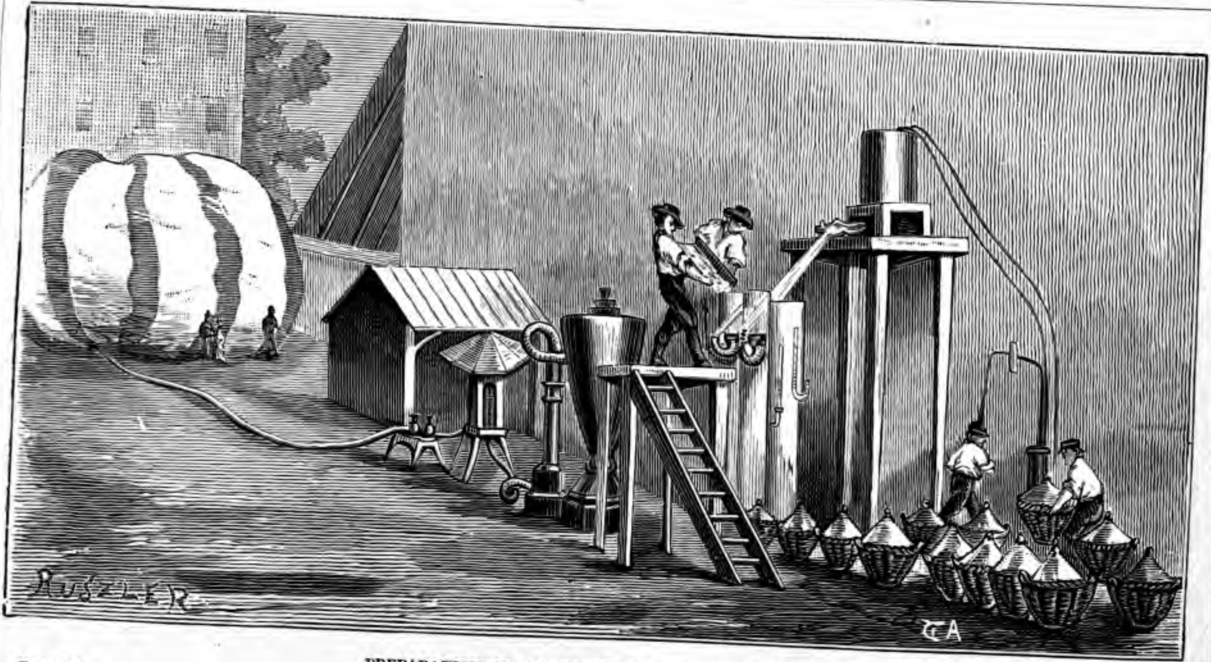
The cable will be able to support a pressure of 45 tons at its lower end, and about 30 at its upper end. The steam-engine will have a motive power to control the ascent and regulate the descent at a rate of about 10 feet per second. From thirty to forty people will be taken up at once, according to weather, with several tons of ballast and guide-rope; everything, indeed, necessary for an ordinary ascent. An observatory, with large self-acting and registering instruments, will be established on board.

Every passenger will receive a commemorative medal, and a map showing Paris as seen from the captive balloon of 1878. Special ascents will be made to observe the transit of Mercury across the sun, which will be partially visible at Paris, in the beginning of May.

M. Giffard has already begun the experiments for preparing his hydrogen gas, by a continuous process which permits the sulphate of iron to be collected for industrial purposes. The plate which we have designed gives a correct idea of the process. A reservoir of acid and a reservoir of water have been placed on the top, the reservoir of acid being the smaller. Acid and water are transmitted to a cast-iron boiler, strongly coated with a sheet of lead. They are mixed when falling by the same pipe which generates a degree of heat amounting to 190° Fahr. The boiler is filled up with iron filings which are acted upon, and the reaction is so strong that the liquid is warmed to 212°.

When the provision of iron filings has been exhausted, another lot is thrown in by opening the cover. The men are exhibited in the act of executing this operation. This interesting operation is done so quickly that the loss of gas escaping during the process of opening is quite immaterial. The gas, after having been produced, is sent through a purifier, cooled, and conducted by the pipe into the balloon. The production is quite regular, and the liquid which has been passed through the iron filings is received in large tanks, where the sulphate of iron is collected after having been crystallized. To facilitate the preparations, a certain quantity of iron is added to the liquid, in tanks, to destroy the small quantity of acid which has escaped.

A number of balloons have been sent up with



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PREPARATION OF HYDROGEN GAS—M. GIFFARD'S PROCESS.

pure hydrogen at a reduced expense, the sale of the sulphate already covering half the costs. The reduction of cost will be greater still when contracts will have been made with large consumers of sulphate of iron, and the process of crystallization brought to its utmost perfection.

At present the only industry which is supported by balloons is the preparation of small indiarubber globes. This is carried on on an extensive scale, about 100,000 balloons being manufactured daily; one half of that immense quantity is prepared by M. Brissonet, of the Boulevard Sébastopol, Paris. The French peasants purchase such balloons from pedlars at prices varying from 2*d.* to 5*d.*, according to circumstances. Quantities of small apparatus for inflating these little balloons have been sold for the use of families. One of the vessels is to receive acid, water, and iron ; the sulphuric acid is poured on in small quantity, it being carefully ascertained that the cork is secure. It would be dangerous to pour the sulphuric acid before the water, or to place the head near the hole, as some drops might be sent up and fall into the eyes.

With a few precautions it is an exceedingly amusing and interesting toy, the price of the indiarubber balloons being very small.

Some inventors have in recent years attempted to render small balloons serviceable for public instruction : alphabets, maps of the world, and even Russo-Turkish war maps have been printed on them. The devices invented vary according to the state of the public mind; we had in some places *Vive la République,* and in other parts *Vive Pie IX.*

CHAPTER XLVI.

BALLOONING AND ARCTIC EXPLORATION.

THE idea of making use of the balloon to reach the North Pole is chimerical so long as a method of directing balloons has not been discovered. It would be mere madness in an exploring party to leave the solid earth, or almost equally solid ice, and trust themselves to the fickle air, at such a distance from all human help, and under circumstances so terrible. But it seems now to be admitted that it would be impossible by the Smith Sound route to go beyond Captain Markham's farthest point without the employment of new methods.

Captain Howgate, of the United States army, who has devised a scheme for planting a colony at Lady Franklin's Bay, to remain there until the Pole is reached, understood too well the difficulties of the undertaking to leave out of his programme any means likely to conduce to the attainment of the end in view. The proximity of an abundant supply of coal suggested the idea of preparing gas on the spot and inflating balloons. The preparation of the gas must of necessity be accomplished without the use of acid, and if possible of iron, although there is always a lot of waste iron to dispose of in a large marine expedition.

In connection with Arctic exploration, balloons might be used either to ascertain the directions of the various currents of air, or to transport to a distance a party who could return either by water or on the ice if the wind did not blow in the desired direction. As the north coasts both of Greenland and America (Grant's Land) have been explored to some distance from Robeson Channel, the difficulties of returning would be considerably lessened. Still the difficulties in the way of using balloons for such a purpose in Arctic exploration are undoubtedly great, although so experienced an aeronaut as Mr. Coxwell seems to think the experiment well worth trying; and in a letter to Commander Cheyne, who is eager to lead an expedition to the Pole, the veteran balloonist has sketched a plan which he seems to think would have a good chance of success. At all events a captive balloon with a cable of as great a length as possible might be of great service in ascertaining the nature of the region for many miles beyond the farthest point yet reached. The car of a Polar balloon would have to be constructed so that it might be utilized according to circumstances, either as a sledge or a boat, so that the explorers might take advantage of whichever of the three elements might be most practicable—air, water, or ice.

I am, at this present winter, endeavouring to organize preliminary researches and experiments in connection with Captain Howgate's Polar expedition, which is to start in July, 1878.

I wrote in June 1877 to Captain Tyson, so well known in connection with the remarkable Arctic expedition in the 'Polaris,' offering my services as a scientific observer and historiographer in connection with Captain Howgate's expedition, and proposing at the same time to organize a balloon service, if such a method of exploration were deemed admissible. My proposal was replied to as follows by Captain Howgate, dated from the "War Department, Office of the Chief Signal Officer, Washington, D.C., August 16, 1877.—Your valued favour of the 16th of June, addressed to Captain Tyson, was forwarded to me for reply. This reply has been necessarily delayed by the amount of work thrown upon me during the fitting out of the 'Florence.' But I avail myself of this first opportunity to say that, should Congress, as I hope, legislate favourably for the proposed Arctic colony at its next session, it is my intention to try the value of balloons as an agent of exploration; and your services, so courteously offered, will be thankfully accepted. Your reputation as a man of letters and science is too well known to render such references as you allude to necessary."

In connection with the latest proposed application of ballooning, the progress of which we have endeavoured to trace in the preceding pages, it may not be inappropriate to conclude our little work with a brief account of the arrangements for the novel expedition whose originator is unprejudiced enough to declare his intention "to try the value of balloons as an agent of exploration."

The schooner 'Florence,' Captain George E. Tyson, master, sailed on August 16 from New London for the Polar seas. The purpose of her voyage is to establish a depot of supplies on Northumberland Island, upon which the main Arctic Exploring Expedition, which sails in July, 1878, under Captain H. W. Howgate, is to draw for subsistence while prosecuting his search for the North Pole. The 'Florence' was to arrive at a point on Cumberland Island about August 25. She will cruise therefrom after whale, and when a cargo of bone and oil is made up, go into winter quarters, and establish what the scientific world will know as the Howgate Polar Colony. Captain Tyson's duties in this respect are to engage, as soon as possible after his arrival at the island, at least a dozen Esquimaux families, who by long residence in the Arctic region are inured to the hardships and discomforts of the northern winter; secure a hundred or more dogs, a quantity of native sledges and material for clothing, in the construction of which the native women will be employed during the winter.

In July 1878 Captain Howgate himself will sail in command of the main expedition. This will touch at Disco, on the Greenland coast, about August 1, and there be joined by Captain Tyson a few days later, he transferring to Howgate's vessel the stores gathered through the winter. Thence the vessel under Howgate, with its own and Tyson's crew, will move northward, establishing at suitable distances sub-bases of supplies upon which to fall back in the event of such a step being made necessary. Captain Howgate's plans therefore embrace, besides the grand search for the Pole, the collection of full meteorological, hydrographical, and geological data, and generally a more comprehensive knowledge of the unknown north lands than is now possessed. How exactly the main expedition will be equipped it is yet too early to say. Much depends upon the action of Congress. The vessel used will be larger than the 'Polaris,' and, like her, propelled by steam and sails. Whatever science has constructed for astronomical and other cognate scientific researches will be at Captain Howgate's command if his wishes are carried out, and the fullest equipment otherwise given him. Of private aid he is assured, as several wealthy gentlemen are deeply interested in his scheme.

Captain Howgate is an officer of the United States army, who has done excellent work in connection with what is known on the other side of the Atlantic as the Signal Service, a department including meteorological and similar observations, and demanding high scientific attainments and training. Captain Howgate is also a cool and practical man, at the same time full of enthusiasm, as might be inferred from the scheme of exploration he has devised. Altogether then he appears to be well qualified to be the leader of the proposed Polar Colony, which let us hope will return with the secret of the Pole, whether that secret be attained by means of balloons or otherwise.

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